THE
POPULAR SCIENCE
MONTHLY.

DECEMBER, 1904.

THE RECLAMATION SERVICE.

By F. H. NEWELL,
CHIEF ENGINEER, RECLAMATION SERVICE, U. S. GEOLOGICAL SURVEY.

A RECENT and notable addition to the work of the government in applied science is the creation of the corps of engineers known as the Reclamation Service, an organization under one of the branches of the U. S. Geological Survey. The operation of these engineers grows out of the passage of the Reclamation Act of June 17, 1902, setting aside the proceeds of the disposal of public lands to be used in survey and construction of irrigation works in the thirteen states and three territories of the arid region.

The development of this corps of engineers is a logical outcome of the work of the Geological Survey, and is the result of development along definite lines of research. The beginnings antedate the creation of the present Geological Survey, and are to be found in the reports of Major J. W. Powell, the pioneer in so many lines of research. His report on the lands of the arid region early attracted attention to the importance of irrigation, and when he became director of the Geological Survey he, through his strong interest in the subject, turned much of the work of the survey in directions which led to a larger knowledge of the opportunities of the creation of homes in the west.

In 1888 the director of the Geological Survey was authorized to investigate the extent to which the arid regions might be reclaimed, and appropriations were given with special reference to mapping the catchment areas of the principal rivers and obtaining a broad knowledge of the entire country.

In 1894 specific appropriations were had for stream measurements, and these were gradually increased, resulting in the operations of the

Hydrographic Branch of the Geological Survey. With the acquisition of facts concerning the rivers of the west, their fluctuations, the opportunities for storage and for diverting the waters upon arid land, came a more definite appreciation of the importance of the whole subject. The people of the United States, stimulated by the irrigation congresses and Irrigation Association, urged upon their representatives in congress the enactment of a law recognizing the conditions.

One of the first acts of President Roosevelt was to recommend the passage of a national irrigation law, and the intelligent interest shown by the president in directing and furthering the efforts of other public men culminated finally in the passage of the Reclamation Act. This

SALT RIVER, ARIZONA, AT DAM SITE OF PROPOSED TONTO RESERVOIR
The dam will be 240 feet high.

places at the disposal of the secretary of the interior a fund which now amounts to nearly $25,000,000 and is steadily growing.

Immediately upon the passage of the Reclamation Act the secretary of the interior authorized the director of the Geological Survey to utilize the services of the men who had been studying the subject, and to add to their number from time to time other experienced men, selection being made from competitive civil service examination. By these means the Reclamation Service has been gradually built up in the Hydrographic Branch of the Geological Survey, until now it includes about 250 engineers of various grades and classes, including men of wide experience in constructing and consulting capacities.

Young men, graduates from technical schools of good repute, are admitted for examination to the lowest positions and designated as hydrographic aids. As they demonstrate their ability and gain experience they are advanced to the position of assistant engineer, and finally to that of engineer. The service is organized on such a basis that the responsibilities are directly placed, and in matters of judgment the advice of consulting engineers and experts can be had.

The operations of the reclamation service began with a reconnoissance of the entire arid and semi-arid regions. The maps prepared by the topographic branch of the Geological Survey are utilized and the geologic facts which bear upon the occurrence of water above or underground are considered. In fact, every branch of scientific research

DRIVEWAY AT PHOENIX, ARIZONA. IRRIGATED PALMS.

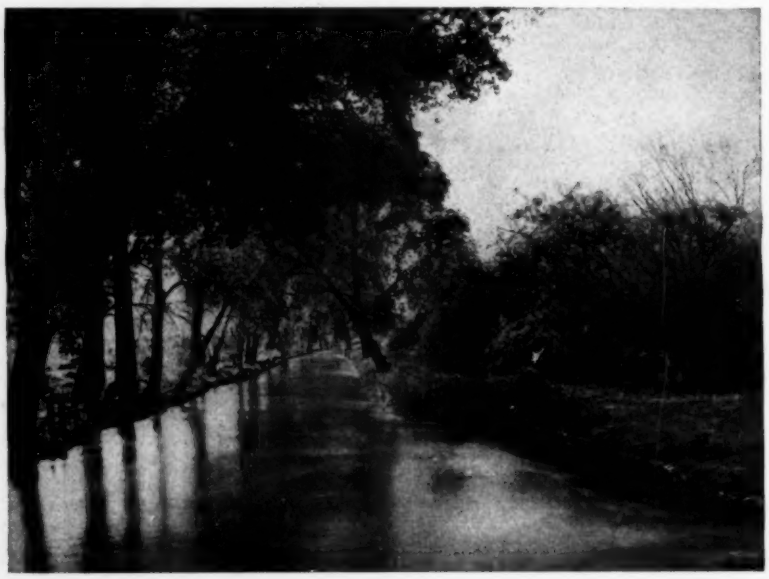
which relates to the storage and use of waters is a subject of concern.

The principal work is, however, not merely to bring the facts together, but to put these to practical application in the construction of large hydraulic works, such as dams for storing the water in reservoirs, or diverting it from the rivers through canals or aqueducts for conveying it to arid lands. These works are carefully planned and the designs and specifications are passed upon by boards of engineers thoroughly familiar with the subject. When a district engineer, that is to say an engineer in charge of the operations in a drainage basin, has brought his work to a point where it can be passed upon, a project board is convened, the members of which have had broad experience in

designing and constructing under similar conditions, and who already know the essential local facts from personal observation.

The project board takes into consideration all the facts as to water supply, foundations and materials for construction, the design and operation of each part of the work, and the character of the lands to be supplied, the climatic conditions and innumerable details. After going over the conditions on the ground the project board prepares a brief report and recommendations, these being submitted through the regular channels for the approval of the secretary of the interior. When instructions have been received from the secretary contracts are prepared after advertising, in the usual fashion.

Work of construction has already been begun in Arizona, Nevada,



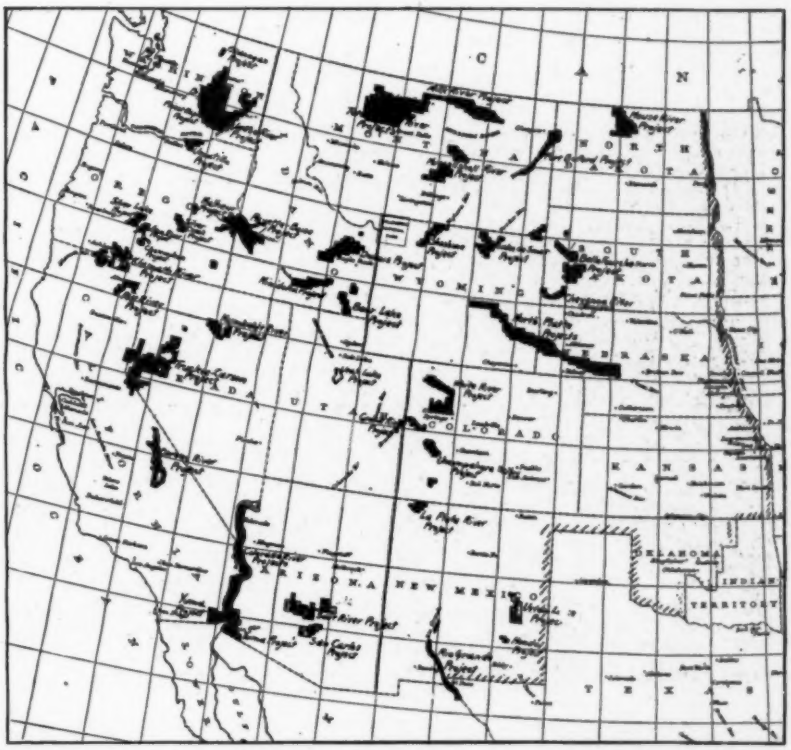
TYPICAL VIEW ALONG IRRIGATION CANAL, ARIZONA.

New Mexico, Colorado and Idaho, and will soon be taken up in other states and territories. In the two and a half years which have elapsed since the passage of the act the conditions in the west have been thoroughly considered, and already funds have practically been allotted to the more important and beneficial projects. The work has not only been on a large scale, but it has been necessary to establish many important precedents and to create institutions which are designed to last for centuries.

The Reclamation Act is very broad and leaves for executive discretion innumerable important details, but it guards carefully a number of points of possible failure. Discretion has been exercised with a

view to perfecting an organization to meet the demands of the future, and special attention has been devoted to securing the economical and efficient carrying out of the purposes of the law. It may be said that the early dangers are passed and that now the work is assuming something of a permanent or routine character, resulting from the experience already obtained.

The following list gives alphabetically by states and territories the principal projects in hand, the acreage which may be reclaimed, and the



PRINCIPAL RECLAMATION PROJECTS UNDER INVESTIGATION BY THE RECLAMATION SERVICE, OCTOBER, 1904, INDICATING APPROXIMATE AREAS WITHIN WHICH PUBLIC LANDS HAVE BEEN RESERVED. SLOPING LINES INDICATE EASTERN BOUNDARY OF RECLAMATION STATES.

estimated expenditures or allotments already made. It is not possible to give with precision the acreage or cost, as there are almost innumerable contingencies, and it has not been considered wise to delay in order to ascertain with great exactness all the conditions which may be met. For example, the acreage to be reclaimed may be more or less dependent upon legal conditions or land titles to be secured, and the area will also be modified when a more complete knowledge has been obtained acre by acre of the reclaimable lands.

In the column headed 'allotment' is given either the amount of money set aside by the order of the secretary, or the restricted fund, so called, which is to be expended in each state according to the feasibility of the project found. The Reclamation Act provides that the major portion of the fund shall be spent in the state or territory from which it originates if practicable. In a number of states where the question of practicability is under consideration, the restricted portion of the fund has been temporarily set aside pending definite action.

State or Territory.	Project.	Acres.	Allotment.
Arizona	Salt River	160,000	3,000,000
California	Yuma	100,000	3,000,000
Colorado	Uncompahgre	100,000	2,250,000
Idaho	Minidoka	130,000	2,600,000
Kansas	Pumping (?)	2,000	49,903*
Montana	Milk River	60,000	891,991*
Nebraska	North Platte	100,000	1,000,000
Nevada	Truckee	200,000	3,000,000
New Mexico	Hondo	10,000	240,000
North Dakota	Ft. Buford and pumping	60,000	1,737,111*
Oklahoma	Otter Creek (?)	40,000	1,301,590*
Oregon	Malheur	90,000	2,000,600
South Dakota	Belle Fourche	60,000	2,100,000
Utah	Utah Lake	20,000	154,199*
Washington	Palouse	100,000	1,395,035*
Wyoming	Shoshone	100,000	2,250,000
	Total	1,332,000	$26,970,429

In addition to the principal projects above listed, reconnoissance surveys are being carried on in each of the thirteen states and three territories, and alternative projects are also being examined with a view to construction if the principal projects, for any reason, are found to be impracticable. It is proposed to have these alternative projects carefully examined and ready for construction as soon as the principal projects are out of the way. The following paragraphs give briefly the present state of knowledge concerning each of the principal projects:

Arizona.—The Salt River project contemplates the storage of water for approximately 160,000 acres of land and the development of pumping facilities for an additional acreage. The cost will probably be about $20 per acre, and ultimately from three to four million dollars may be expended.

California.—The Yuma project, on the Lower Colorado River, as now outlined involves the reclamation of 85,000 acres at a cost of $35 per acre, the land being on both sides of the river in California and Arizona.

Colorado.—The Gunnison project contemplates the reclamation of 100,000 acres of land in the Uncompahgre Valley, at a cost of about $25 per acre. This land is largely in private ownership. The project

* Restricted fund.

involves the building of a tunnel from Gunnison River, six miles in length and requiring four years to build.

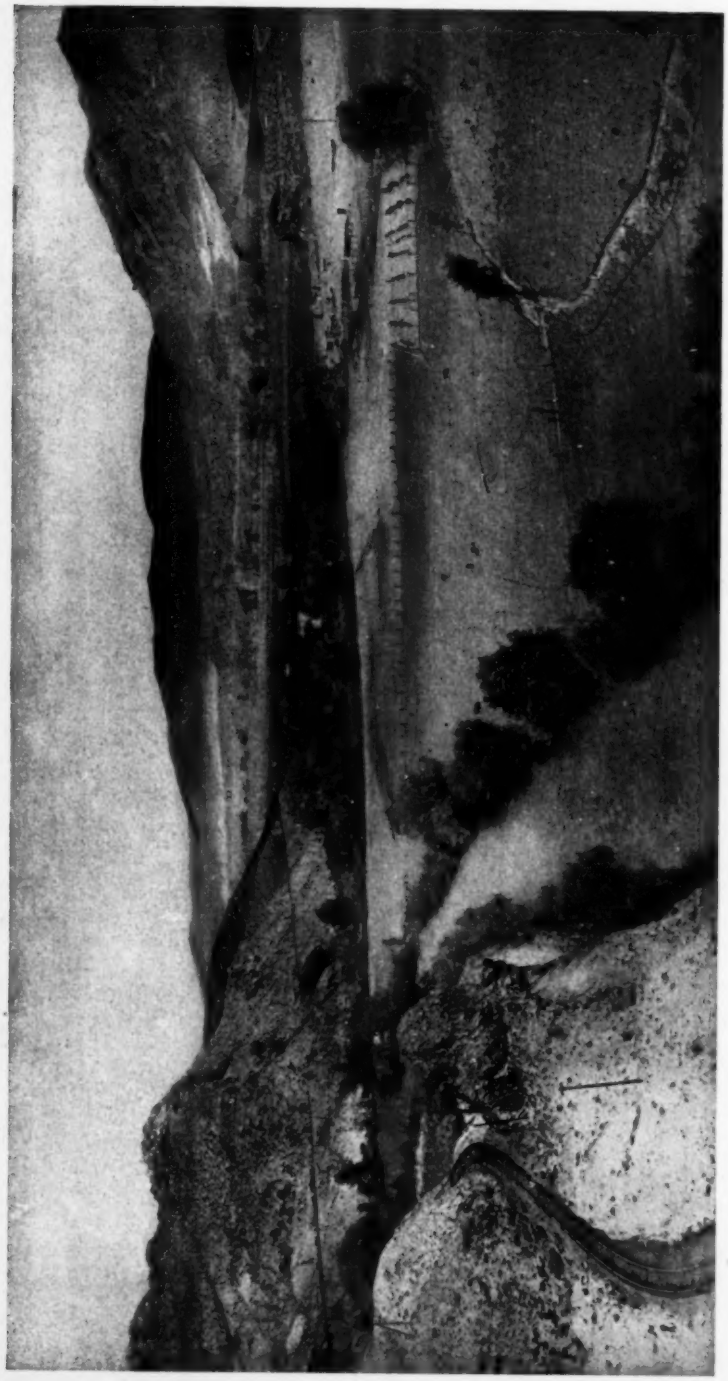
Idaho.—The Minidoka project is for the reclamation of 100,000 to 120,000 acres of vacant public land on both sides of Snake River, at a cost of $26 per acre. This is to be accomplished by the construction

GUNNISON CAÑYON NEAR HEAD OF PROPOSED DIVERSION TUNNEL.

of a dam and canals and development of the gravity and pumping systems.

Kansas.—Investigations are being made of the feasibility of pumping water in Kansas, and particularly of the quantity and rate of movement of the so-called underflow of western Kansas, and the practicability of bringing this to the surface.

Montana.—The Milk River project is for the reclamation of nearly 60,000 acres of land, mostly public, and located mainly on the south



TRUCKEE VALLEY NEAR WADSWORTH, NEVADA.
Truckee River will furnish part of the water for the extensive Truckee-Carson irrigation project.

side of Milk River, east of Malta, Montana. The cost will be from $20 to $25 per acre.

Nebraska.—North Platte project is for the reclamation of an undetermined area of land east of the Wyoming boundary and the building of a canal on the north side of North Platte River. Some of this land is now in private ownership. The cost of reclamation will probably be between $35 and $40 per acre.

Nevada.—The Truckee project now under construction will reclaim upwards of 150,000 acres at a cost of about $25 per acre. There are a number of ramifications which are yet to be worked out and these may result in a larger development.

New Mexico.—The Hondo project in the vicinity of Roswell will irrigate about 10,000 acres, a portion of which is in private ownership. The cost will be upward of $25 per acre. Water is to be obtained from flood storage in a reservoir to be constructed on the north side of Hondo River.

North Dakota.—Fort Buford project is to reclaim 60,000 acres of lands on the west side of Yellowstone River in Montana and North Dakota, at a cost of about $30 per acre. Most of this land is in private ownership.

Oklahoma.—In this territory investigations have been made of the opportunity of storing water in a number of shallow basins, but as yet the results have not been satisfactory.

Oregon.—The Malheur project, on both sides of Malheur River, west of Ontario, will reclaim, by a storage of flood waters of Malheur River, about 90,000 acres at a cost of about $30 per acre.

South Dakota.—The Belle Fourche project contemplates the reclamation of 60,000 acres of arid land, largely public, situated northerly from the Black Hills. This is to be accomplished by the storage of flood waters of Belle Fourche River. The cost will be about $32 per acre.

Utah.—The Utah Lake project contemplates the utilization of waters tributary to Utah Lake and the reduction of evaporation losses by drawing down the lake. It is possible that 20,000 acres may be reclaimed at a cost of $35 per acre.

Washington.—The Palouse project is for the reclamation of arid lands near Pasco, by storage in Washtucna reservoir. Possibly 100,000 acres, mainly in private ownership, can be reclaimed at a cost of $35 per acre.

Wyoming.—The Shoshone project is for the reclamation of 100,000 acres of public land in the Big Horn Basin, north of Shoshone River. Water will be stored and diverted at a cost of $25 per acre.

Most of the systems for irrigating land depend wholly upon the gravity supply of water, but in a number of localities it will be neces-

sary to use pumps. For this purpose plans are being made for the development of water power and the use of this in pumping by electric transmission. It is believed that in this way considerable areas of desert land can be reclaimed which are now out of reach of water obtained by the usual methods. Scientific investigation is being pushed along these lines, and also in many other directions, and of the employment of cement and concrete in construction. In short, the scientific work, while subordinated to the so-called practical side, is receiving constant attention from the various experts.

Assistance is being given to the reclamation service by the operations of the other divisions of the hydrographic branch. These are three in number: first, the division of hydrography, which has to do with the scientific measurements of the flow of the streams; second, the hydrologic division, which is studying the hydro-geology, or the bringing together all the facts bearing upon the occurrence of water in its geologic relations, and third, the hydro-economic division, which has to do with the quality of water and the relation which the changing qualities have to the industrial uses. In particular the quantity of saline matter carried in solution is of prime importance to the question of irrigation, and next to this the character and amount of material carried in suspension.

The operations of the Hydrographic Branch, including the Reclamation Service, illustrate the evolution which may take place under suitable auspices from the small beginning of a scientific investigation, leading up step by step to the practicable operations of applied science in building great works to endure for centuries. It is significant of modern times to find the engineers and scientific men taking a larger and larger part in the executive business of the world, and bringing to it the training of the technical school and laboratory, as distinguished from that of the counting-house or lawyer's office.

CHINESE AND JAPANESE IMMIGRATION.

By Dr. ALLEN McLAUGHLIN,
U. S. PUBLIC HEALTH AND MARINE HOSPITAL SERVICE.

ABOUT twenty years ago the tide of Chinese coolie laborers assumed such proportions that the Chinese exclusion act was enacted to protect the Pacific states from the horde of yellow parasites which threatened their prosperity. The radical step of legislating against a race was taken after due deliberation, and recognition of its urgent necessity. The Chinese exclusion act has worked fairly well, and in 1901 was reenacted. It is not perfect, and evasions have been frequent, as might be expected in a people fertile in resource and schooled in trickery and deceit, as are the Mongolians, but on the whole the object aimed at has been attained. It has kept out the mass of yellow coolies who would otherwise have come here, and has practically confined the question of Chinese coolie labor to the Pacific coast, whereas, without it, we should have had the coolie labor in Illinois, Pennsylvania and every other state in the Union.

One of the many methods employed by Chinese in evading the exclusion law is of particular interest because of its bearing on illegal naturalization of aliens. Naturalization of Chinese is often an incident of a successful attempt to evade the Chinese exclusion law. A Chinaman arrested in crossing the Canadian border will claim he is a native of the United States and is able to produce Chinese witnesses who will swear to his nativity. He is not only admitted, but is admitted as an American citizen—and his children born in China will also be entitled to admission to the United States and undoubtedly in time will also claim citizenship. An officer detailed to examine the conditions existing upon the Canadian border, in his report to Hon. F. P. Sargent, Commissioner-General of Immigration, makes the following statement, published in the 'Commissioner-General's Report' for 1903:

Hon. F. P. Sargent,
Commissioner-General of Immigration, Washington, D. C.

Sir: . . . To acquaint myself with all that might bear on the subject, I called at the Chinese bureaus at New York and Boston, conversed with the Chinese inspectors and interpreters, attended the trial of cases at Ogdensburg, interviewed the Chinese themselves at different points in their own language, read whatever notices I saw in Chinese, called at their stores, schools, restaurants and laundries, and at every opportunity gathered what information I could on the subject.

I found that in this section of the country Chinese gain admission into the United States by smuggling, by applying openly through the regular channels as members of the exempt classes, or by surrendering themselves a short distance from the border for arrest and trial, as a rule, under the guise of being natives of the United States. As to the first-mentioned class, the number is being reduced, owing to the constant vigilance of our officers on both sides of the border. As to the second class, the inspector in charge of the Brooklyn district, as well as the one in charge of the Boston district, I found to be good, efficient officers, and cases are submitted to a thorough investigation. It is the third class—that of the so-called 'natives'—that calls especially for correction. There are several points near the Canadian border, such as Malone, Ogdensburg, Plattsburg and Rouse Point, where Chinese of the class last mentioned are taken for trial. This class comprises Chinese who have come from China and have camped at Montreal, until such time as the members of the ring engaged in working up their defense could secure witnesses to testify to their alleged nativity.

I attended the trial of several such Chinese, on whose behalf the claim of being natives of the United States was made, which, I was creditably informed, fairly illustrated the usual method of trying this kind of cases. At the time set the case of Ah Sing or some other Ah would be called, and with the defendant absent from court throughout the whole session one other Chinese would be put upon the stand to testify to the defendant's having been born in the United States—most likely in the Chinatown of San Francisco, the alleged birthplace of tens of thousands of others that have made the claim at various times and at various places before him. Upon the uncorroborated testimony of this one Chinaman the other Chinaman, awaiting the issue in jail, would be declared a native of the United States. This goes on week after week and month after month, and has been going on for years. One of the Federal judges estimated that if the story told in the courts were true, every Chinese woman who was in the United States twenty-five years ago must have had at least 500 children. (Report of Proceedings of Chinese-Exclusion Convention, held at San Francisco, November 21 and 22, 1901, p. 51.) By this method thousands of Chinese—upon the admission of the Chinese themselves—have been allowed not only to enter and remain in the United States, but declared to be native-born citizens thereof, each with a vote and qualified to participate in the political affairs of this country.

How far-reaching the effect of such a method is can be appreciated only when it is borne in mind that not only the Chinese who may be thus admitted are made citizens, but also their alleged children, though born in China.

That Japanese are naturalized illegally is shown by the report of special examiner C. V. C. Van Deusen, published in the 'Report of the Attorney General of the U. S.,' 1903. Mr. Van Deusen says:

Notwithstanding the fact that the Federal statutes exclude from the rights of citizenship all persons except free white persons and those of African nativity and descent, courts have admitted to citizenship persons not belonging to either of those two races. This is particularly true of courts on the Pacific coast, which have naturalized many natives of Japan, and the clerks of which still continue to accept from such persons declarations of intention to become citizens. As several of these clerks have admitted to me the fact that they know that the naturalization laws exclude Japanese, their demand for an acceptance from these people of the naturalization fees brings them dangerously close to the penal provisions of statutes bearing upon unlawful practises.

The Japanese has never been placed under the ban to which his Mongol brother, the Chinese, is subjected, because not until recently did Japanese immigration reach proportions of alarming size. The rapid increase of Japanese immigration is shown by the table given below.

Years.	Japanese Arrived.
1898	2,230
1899	2,844
1900	12,635
1901	5,269
1902	14,270
1903	19,968

The Japanese coolie labor is (according to some observers who have made a special study of them) more undesirable than the Chinese. There are thousands of these Japanese working in the orchards, vineyards, gardens, hop and sugar-beet fields of California.

The investigations of the California State Labor Bureau show that the Japanese usually come here in gangs of twenty-five or more, and are controlled by Japanese boarding-house keepers in San Francisco, Seattle and other Pacific ports, the system resembling the 'padrone system' of the Italians. These Japanese boarding-house keepers or bosses are in touch with so-called 'Immigration companies' in Japan. Mr. Thos. F. Turner, in his able report upon Chinese and Japanese labor in the mountain and Pacific states, prepared for the Industrial Commission, and presented by it to Congress, December 5, 1901, says:

A contract is entered into by one of these immigration companies with every Japanese immigrant coming to the United States By the terms of the contract it is provided that the immigration company shall secure passage for the immigrant to the United States, with necessary passport, and that it shall provide for all his creature comforts while *en route*, and return him to Japan in case of sickness. Fully 80 per cent. of all the Japanese who come to the United States are classified, as shown by the reports of the immigration office, as farmers. The wages of farm hands in Japan are 3 to 4 yen per month, or about $1.50 American money, without board or lodging; yet every one of this class of immigrants, after paying passage to the United States, is able to show to the immigration officer $30 in gold. It is understood by the immigrants that they must have at least this amount in order to secure landing in the United States.

It is a fact full of significance that of the hundreds of coolies who are constantly coming into the United States every one produces just $30 in gold; no more, and no less.

That the entire system of immigration companies, boarding-house keepers and Japanese bosses is but an elaborate and ingenious method of avoiding our contract labor laws, no one who has investigated the subject can doubt.

The following is an exact translation of one of the immigrant contracts referred to:

CONTRACT

The Nippon Imin Goshi Company will contract, accepting the request for transportation, of Yoshida Ichitaro, who is a free emigrant, having the purpose to land in San Francisco, North America, and to secure for him work there, within the limitations prescribed by the immigration laws.

1. The emigrant shall perform everything that is needed for getting the passport and must be responsible for all expenses needed for the voyage, and should have the money which is necessary when landing.

2. The maturity of the contract is three years from the date that the emigrant starts.

3. If the emigrant gets sick, or loses the means to get along, Narita Toyashira, agent, will help him and provide him means to get back to Japan in case it is necessary.

4. If the emigrant is sent back at the expense of the Japanese government the company shall pay all the expenses for the emigrant.

5. The emigrant shall pay 10 yen to the company as its fee. If the emigrant has a child who does not exceed the age of 15 years, the charge for it will be half price, and if the child is not exceeding 10 years of age, he will be carried free of charge.

6. The emigrant shall provide two securities to the company according to acts 3 and 4 thereof, and they will be responsible to pay all of the expenses that have been paid by the company under the provisions of sections 3 and 4.

7. The two securities are responsible in all the matters pertaining to the emigrant.

This contract is made in duplicate, one to the emigrant and one to the company.

Meiji, 31st year (1898), 1st month (January), 31st day.

HAMANAKA HACHITARO,
Special Manager Japan United Immigration Company.

Emigrant:

YOSHIDA ICHITARO,

Securities:

YOSHIDA YOHEI.
YAMAMOTO KUSU.

There is every ground for the belief that the $30 which is exhibited by the immigrant to the United States officials is furnished by the immigration company. The whole scheme is a flagrant violation of our contract labor laws. The class of Japanese immigrants who are thus enabled to come to the United States are of the most objectionable character, and without the assistance of such organizations would be compelled to remain in Japan. The United States Government should take immediate steps to suppress these immigration companies.

The great danger to the laboring interests of the United States of unrestricted Japanese immigration will be better understood after an examination of the following table showing the prevailing rate of wages paid in Japan in the various lines of industry:

JAPANESE WAGE RATES PER DAY.

	*Yen.	United States Money.
Carpenters	0.55	$0.26
Plasterers	.55	.26
Stonecutters	.65	.31
Paper-hangers	.50	.24
Joiners	.60	.29
Tailors for Japanese clothing	.50	.24

* A yen is valued at 48 cents.

	Yen.	United States Money.
Tailors for foreign clothing	1.00	.48
Blacksmiths	.75	.36
Printers	.40	.19
Ship carpenters	.60	.29
Compositors	.60	.29
Common laborers	.40	.19
Confectioners	.35	.17
Farm laborers, per month	3.00	1.44

It is little wonder that these strange foreigners, when they come to the United States, are willing to work for 60 and 70 cents a day, which is more than double the wages for which they were compelled to work in Japan. As a result of this unnatural competition the white laborer has been driven from the field wherever the coolie system has found a foothold.

The Japanese adopts our dress and manners, but his Americanization never extends beyond external appearances. The yellow and the white races are as immiscible as oil and water. No forces of education or civilization can make aught but an Asiatic out of a Chinese or a Japanese. There can be no assimilation, nor do they desire it. They simply intend to hoard a certain amount of American gold and go back to Japan or China to pass the remainder of their lives in comparative ease. While here, their one idea is the hoarding of money; to earn as much and deny themselves as much as is compatible with human endurance. They have no interest in our government, in our laws or in us, other than that which concerns the attainment of their object.

Aside from the economic aspects of Japanese immigration, there is one other objectionable feature of this second yellow invasion which is worthy of note. They bring more cases absolutely and relatively of contagious disease than any other nationality coming here. During 1903, one Japanese out of every 37 arrived was deported as afflicted with a loathsome or dangerous contagious disease. The coming of the Japanese merchant, professional man or student should be permitted, just as we now permit the same class of Chinese to enter freely, but the coolie laborer, whether Japanese or Chinese, is an unfair competitor for our white laborer, and with his high percentage of disease is an element of danger to the public health.

THE STATUS OF AMERICAN COLLEGE PROFESSORS.

By Professor JOHN J. STEVENSON,
NEW YORK UNIVERSITY.

THREE months ago, the colleges and universities opened for the new year. In most instances, telegrams from the institutions were jubilant, announcing that the entering class is the largest in the history of the college, but some were apologetic, as one or another department showed decrease. Editors rejoiced in the 'era of education,' pointing with pride to the four hundred and fifty colleges, more or less, with about 15,000 instructors and about ten times as many students and a total income for all purposes approaching $25,000,000. Unquestionably, there is much in this of which to be proud, but the broad statement, as given in the journals, fails to emphasize the fact that this great fabric of higher education owes its existence, in great measure, to the willingness of college professors to bear a great part of the cost. It is true that college professors have never received salaries such as to arouse envy in men of other professions, but, at one time, the calling offered great attractions to those who cared more for study than for money. Appointments were made for life or good behavior, the calling was honorable above all others, as in Germany of to-day, and there was that 'literary leisure' which could be devoted to investigation. Many imagine that there has been no change in these conditions; this error should be corrected.

The scope of instruction, especially on the scientific side, but measurably on all sides, has been widened and the hours have been scattered so as practically to cover the available day. The kind of knowledge required is very different from that of even thirty years ago, when students had hardly any source of information outside of the text-book and classroom and the courses were truly elementary. Immediate preparation required little time and the professor's close study was within a chosen field of investigation; but now he must read carefully the literature in all portions of the field covered by his chair merely to meet the exigencies of the classroom, for the elementary courses of little more than thirty years ago belong to the common stock of knowledge; popular magazines deal with discoveries in science and archeology, as though they belong to familiar discourse, and daily papers indulge in editorial discussions of subjects which, twenty-five years ago, were in the province of specialists alone. There remains for the college professor hardly a trace of 'literary leisure,' and even the university professor is apt to find the stress of outside duties con-

nected with his work so exhausting that, during term time, any prolonged study beyond that which is necessary becomes irksome.

Two generations ago, college trustees kept themselves more or less in touch with the professors and made diligent effort to become familiar with details of the work. With vast expansion in resources and equal expansion in the curriculum, personal relations between professors and trustees practically ceased and the latter have no longer time, opportunity, or, in too many cases, inclination, to acquaint themselves with the nature or extent of the work done by individual professors. University faculties have rarely any direct representation in the board of trustees or before it, the common mouthpiece being the president, who, no matter how earnest and faithful he may be, is not, in the very nature of things, competent to understand all matters or to present them properly. In too many cases, the professors are not consulted even in the matter of appointments and the trustees place the responsibility for these upon the president, as though the institution were a country academy. Naturally enough, trustees have come to regard themselves as the institution and the professors as merely their employees, as, indeed, has been asserted. This has gone so far that in one institution, at least until a very recent period, all appointments were for the period of one year—a plan admirably adapted to secure adherence to the powers in control. For trustees having this conception of their powers and duties, the usefulness or worth of an instructor is not measured by his ability as teacher or investigator.

Certainly the attractions making the profession so inviting in former days no longer exist in such form as to be magnetic to ambitious young men.

It might be supposed that, on the whole, salaries have been increased so as to compensate in some degree for the losses; and the relation of income to number of instructors, as given in the opening paragraph, appears at first glance to confirm the supposition. But not so. Salaries, always small, have not been increased to keep pace with cost of living or even with other demands unknown two generations ago. On the contrary, taken as a whole, the salaries have decreased. The writer recognizes that salaried men are at a disadvantage in comparison with ordinary wage-earners, the advance of salaries being slow and the periods of rest usually long; but college men are at especial disadvantage owing to peculiar conditions, which have been intensified during recent years.

College income must come mainly from endowments or their equivalent. Students' fees, though not unimportant, pay but a small part of the cost. Little more than two generations ago, when college faculties were small, the course compulsory and free tuition almost unknown, fees were the chief source of income. With increase in number of students, old buildings became insufficient and new buildings were secured by sale of long time scholarships at low rates, the future

being heavily mortgaged for the present. After the civil war, a vast army of students entered our colleges; the fees were increased somewhat in many cases, but not in proportion to the cost, and the system of free scholarships became an important feature almost everywhere. More buildings, more and attractive grounds, were acquired and in time a large share of the income went toward mere maintenance of the property. To make matters worse, the colleges soon suffered an actual loss of income, for owing to the decreasing rates of interest, the endowments, such as they were, became less and less productive, while, in addition, the broadening of the curriculum compelled greatly increased expenditure. Fifty years ago there were institutions doing excellent work for the times with only six or seven salaried men in the faculty, averaging one instructor in some cases to forty students, whereas to-day the multiplicity of courses requires an instructor to every ten or even less students.

Increasing outgo without corresponding income must be at somebody's expense, and, in this case, that somebody is the college instructor. Not that in every case the salary of a professor has been reduced in order to pay the cost of dividing his chair, so that the college may receive twice as much work for the same money—though this is not unknown—but that a newly appointed man in many cases receives less salary than his predecessor. It is by no means rare for a college, on the retirement of a professor, to divide the chair, employing young men at salaries which, combined, amount to little more than the single salary fixed many years before. Even so, not a few of our colleges have alarming deficits at the end of each year.

No doubt this arouses astonishment and some may be disposed to ask, in view of the immense gifts for educational work made during the last twenty-five years, if such a condition of things does not prove incompetence in the business management of colleges. Not at all; the error is not in that. The financial management, in most instances, is beyond criticism, more, it deserves the highest praise, and in many institutions the trustees are not merely competent, they are devoted and conscientious, dealing with college business as with their own. As the most caustic reflections upon college management usually come from alumni, the writer may be pardoned for a slight digression.

Alumni who contribute a few dollars a year toward the support of alma mater's glee or athletic clubs are apt to take their display of affection altogether too seriously. They seem to feel convinced that by attending the college and by securing a degree, whether deserved or not, they have placed their college under such material obligation that they should have a large voice in its control. This notion, which would be grotesque were its effects not so serious, is due perhaps to the constant hunt for students and to the prevalent opinion that the success of a college is measured by the number in attendance. But the

college is under no obligation whatever to the alumnus; its obligations were all discharged when he graduated; on the other hand, the student's pecuniary obligation increases each year, reaching its maximum at his graduation. This matter can not be presented too frequently or too emphatically.

An excellent man of large means once informed the writer that he would never send his grandson to a college in which tuition is free, as he always paid for what he received. He was taken aback when told that, although paying a large sum for his grandson's tuition, he was still an object of charity to the extent of several hundred dollars a year, the cost per student at that institution being, as the writer knew, four times the fee. It is probable that in no college to-day is the cost less than three times the fee, and in those with small fees the cost is proportionately very much greater. Before giving voice to a demand for a share in control of college affairs, the alumnus will do well to discharge the debt of $1,000 to $1,500 which he owes to 'dear old alma mater.' Were alumni to do this, the pangs of poverty would be less severe in many of our colleges.

Returning from this digression. It is very true that immense sums have been given to colleges and universities during the last thirty years and that such giving is likely to continue. Much of the money thus contributed was for the founding of new institutions, too often with inadequate equipment, thus making the condition worse by adding to the number of struggling colleges; much was given for the erection of buildings, most of them needed, but not in all cases useful in proportion to the cost and, until recently, not always endowed; much has been bestowed upon the endowment of scholarships; not a little has gone toward the founding of fellowships for the encouragement of graduate study; some large sums have been given for the advancement of outdoor athletics and intercollegiate contests; and in many cases funds have been provided for the employment of instructors in new branches. But unconditional gifts of money have made up only a small part of the whole, and even where these have been given, those in charge of affairs have rarely seen fit to strengthen the institution by increasing salaries, preferring rather to 'expand' by creating new chairs to be filled by young men at, to speak within limits, modest salaries. In all probability, there are institutions with a net endowment not so great as it was thirty years ago, though showing a great increase in number of students and instructors as well as in property. The average salary is much less and the president's energies are devoted to raising money to meet the annual deficit. So it has come about that the college president of our day has duties very different from those of thirty years ago. The loss of the old-time president has been a disaster and the good of our colleges requires that he be brought back. There should be an officer at the head of the business affairs and

another at the head of the educational affairs. Our universities will not do their work as it should be done so long as the two offices are held by one man.

Some excellent people who have no money, and others who have money but do not give, are quick to censure those who donate buildings instead of funds. College men, being especially affected, are apt to repine much after the fashion of a good professor, who, in speaking of a generous benefactor, said, 'We asked him for bread and he gave us a stone.' But the criticism is unjust. Donors are said to be selfish, seeking only to perpetuate their names. Even so, they have done only what every man ought to do and they have chosen a praiseworthy method; they will be remembered as doers of good. It must not be forgotten that the steady stream of buildings had its origin in the most pressing need of our colleges. At the close of the civil war, colleges had their faculties and the professors were receiving fairly good salaries; but there were not buildings in which to accommodate the rapidly increasing number of students and every effort was devoted to supplying this crippling deficiency. When, later on, it became necessary to add to the staff of instructors, the older professors gladly consented to the lessening salaries, expecting soon to have the conditions restored, but never suspecting that by enduring hardness for the sake of their institutions they were making a standard for the future.

But now, in most of our colleges, additional buildings are not the urgent need; the time has come to impress upon the community the necessity for endowments, that qualified instructors may be obtained so as to utilize properly the buildings and equipment already provided so generously. Buildings are necessary, but they do not make the college, no matter how complete their equipment may be. The college is not here to cultivate public taste in architecture or even to restore the Grecian games; primarily, its purpose is to train men for life's struggle; secondarily, to advance the world's welfare by investigation. Without a thoroughly efficient staff of instructors, the college is a farce, no matter how magnificent its plant may be, how numerous the students or the victories in athletic contests. The prolonged effort to obtain buildings has obscured this fact, and now, with increased cost of maintaining grounds and buildings, with increased and increasing number of instructors to satisfy incessant demands for new courses—which those in authority have not the moral courage to deny—with constantly increasing numbers of students and with practically no compensating increase of income from endowments, the ability of colleges to pay salaries deserving of the name has disappeared. Nowhere in the United States are there salaries which mean more than a very modest living. It is true that a few salaries in the larger cities are such as to appear enormous to those living in small villages; but even those are larger only arithmetically, not in purchasing power;

while they are far more than counterbalanced by the great number of small salaries in the same institutions. These 'large salaries' in themselves are not such as to be inviting to strong men; they are inviting, however, because with them there is offered also some of that 'literary leisure' which is so much desired by the student.

As the result, college chairs are filled in great part by men who, at the most, are but partially dependent on their salaries. In a sense, this was always true. When the hours of teaching were less scattered and the requirements less severe, college men in cities often supplemented their salaries through congenial work outside; while in country colleges, where an almost prerequisite qualification for several of the chairs was ordination to the christian ministry, professors added to their income by preaching. But those conditions no longer obtain, and in some institutions a professor, even if he have the opportunity, may not undertake any outside work without special permission—a perfectly proper regulation. In any event, except in rare instances, no opportunity remains for a professor to engage in outside work during the college year unless he devote only a part of the time to college work, for, as already said, practically the whole business day is demanded. To live in comfort, to retain the respect of the community, one must depend largely on means already acquired.

That this condition, or, rather, combination of conditions, will have a prejudicial effect on the personnel of the profession is not open to doubt; and additional danger lurks in the system of fellowships, which is nothing other than that of hiring young men to pursue graduate studies. Even now, though the system is, so to speak, in its infancy, graduates judge of universities not so much by the standing of the professors or by the grade of instruction offered, as by the value of the fellowships. Students about to graduate have been known to ask their professors what inducement the college offers them to remain—more than that, have been candidates for appointment at more than one institution. Evidently the time approaches when prospective candidates for the doctorate will scan university catalogues as prospective students of theology are said to scan seminary catalogues, to discover which has the longest list of highly productive scholarships.

Formerly a graduate desiring to become a professor usually received appointment at once as a tutor and eventually worked up into some professorship. That was when the courses were all somewhat elementary in character; but now special preparation for a particular chair is demanded. The graduate spends at least three years in study as a specialist, very frequently including a year or more at some European university. On the scientific side, at least, this work is severe, leaving no time for other occupation except at the cost of a dangerous expenditure of energy. Preparation for college teaching

is more exacting than that for any other profession, medicine not excepted.

The prospect of spending seven years in preparation, of working afterwards as an assistant for several years at a salary of $700 or $800, for several years more at a small advance, and of attaining by middle age a salary not much greater than the wages of a switchman in an eastern railway yard, with at the end little hope of a pension is by no means alluring to a man unwilling to remain celibate throughout life. Thoughtful young men in the higher classes of our colleges recognize this condition and recognize also that the compensating privileges of social standing and leisure for research have been reduced to the minimum. This feeling respecting the status of American professors is so widespread that, unless the conditions are modified quickly, the next generation will see a notable change in type of professors; some will be teachers because unwilling to be anything else; some will be men of independent means desiring a not too burdensome occupation; but a large proportion will consist of men carried along on scholarships and fellowships into a profession for which they have neither fitness nor inclination—perfunctory teachers, lamenting their fate in being compelled to 'waste themselves on a parcel of boys.'

To prescribe a remedy is not difficult; to bring the patient into receptive mood is apt to be difficult. The writer suggests a remedy; the administering must be left to others.

The first step should be elimination of mimic universities and restoration of the college with a fixed curriculum, intended to develop the man and to lay foundation for a broad education. By thus removing odds and ends of elective courses and attempts at types of work belonging altogether to graduate study, relief will be given from much which is of doubtful utility to the undergraduate, and the professors will regain that leisure, which for so many years was utilized to the advantage of the whole community.

The second step should be complete readjustment of the relation between the corporate and educational boards. Times have changed and with them the conditions also, but the powers and duties of the corporate board have remained unchanged. Trustees are chosen in view of their fitness to manage the financial affairs, very rarely with reference to their familiarity with educational matters; yet their board has, as of old, the power to appoint professors and even to create new chairs, thus controlling not only the selection of the faculty but also the curriculum, matters with which, in the very nature of the case, they cannot deal intelligently—as a board. The teaching board should have the sole right to name candidates for appointment, to determine all matters concerning the curriculum and the corporate board should be called upon to confirm the action, *pro forma,* whenever a business contract is involved. Details respecting methods of procedure do not

concern us here; what is contended for is a proper assignment of powers and duties to accord with the conditions of to-day as contrasted with those of two generations ago, when most of the great institutions of to-day were little better than are the eastern High Schools. This adjustment would give to the teaching staff its proper standing and the trustees would be guardians of the material interests.

Perhaps this second step should be regarded as the first. It certainly would change in some respects the estimate which some boards entertain regarding the relative importance of trustees and professors. In many colleges, professors have given their services at small salaries, far less than they could have obtained in other directions, have refused calls at higher salaries to other colleges, in not a few instances have reduced their salaries voluntarily and served the college for a pittance, simply to preserve it from destruction. All this they did deliberately, hoping that in the end their college would be placed upon a sound basis and depending upon the good sense of the trustees for proper recognition in due season. Such contributions should be accepted as so much money given annually to preserve the college and the contributors should receive at least as much credit as do such trustees as pay something in actual cash. That this is not the case is well known. When money is received by a college, the trustees should not hasten simply to relieve themselves from their subscriptions, they should share the relief with the professors; and if, at length, sufficient money should come to relieve the actual pecuniary stress and to leave a surplus, common honesty requires that that surplus be devoted toward finally relieving the professors. That done, the time will have come to consider the question of expanding the curriculum and of appointing new instructors. That this is not the view held by trustees of our day is a familiar fact. And yet the condition does not justify any reflection upon the honor of the trustees; it is due solely to the fact that they know little about the professors as men or as workers,—to the constantly widening gulf separating the corporate and educational boards.

In any event, this second step, if taken, would go far toward restoring the profession to its former honorable standing and would go far also toward making possible the third step, which is consolidation.

There are too many academies calling themselves 'college' or even 'university,' with high grade curriculum and low grade requirements, with long lists of pupils in preparatory classes of one sort or another and very short lists of students in so-called college classes. Many of these have no apology for existence aside from the fact that otherwise the religious denomination, which they represent, would have no educational institution in the region. There are in proximity too many feeble colleges, with few college students, with insufficient equipment, with practically no endowment and with makeshift instructors. If a judicious consolidation could be brought about, if the

academy portions could be gathered into a strong academy and the college portions into a strong college, with the academy as its feeder, if higher institutions under similar relations of space could be brought together so as to make a thoroughly equipped college and a thoroughly equipped university, the vast sums now expended on mere maintenance of property could be applied directly to educational work and a long advance would be made toward paying salaries which, with the regained leisure and the regained honor, would make college teaching once more attractive to men of the highest type.

The writer has been told that these propositions are fair and reasonable, that they are merely what common sense demands, but that they are chimerical. One correspondent asserts that they are good but that the world can not go backward. This last is very true, but the truism has no bearing upon the question. If one have strayed from the road in blind trails, he can hardly be reproached for retracing his steps to the parting of the ways, that, taught wisdom by his error, he may advance anew and along the right path.

That the suggestions are chimerical, the writer can not concede; that they involve serious difficulties, he not only concedes but also asserts. The obstacles to be overcome before the second can be realized are comparatively insignificant. If it be a common sense proposition, it will need only proper presentation to secure its acceptance by the business men on the corporate boards and, as far as they are concerned, the adjustment could be effected very rapidly. But obstacles of no mean sort will be encountered in an effort to realize the first and third, most serious of which are those arising from denominational prejudice or jealousy. Almost as serious are those due to individual prejudice or obstinacy. Trustees and teachers are unwilling to acknowledge that their college has no good reason for separate existence, though they know and the community knows that they know the fact. Alumni, whose only manifestation of interest in the college has been an occasional visit to a summer re-union, are apt to display a sudden and emphatic love for *Alma Mater* when consolidation is suggested, putting forth energy enough against consolidation to place the college on a good footing, if properly directed. The writer recognizes all of these difficulties, but is convinced that they will be overcome if only full discussion of the matter can be had, so as to bring it fairly to the attention of those on whose gifts the American college depends for development.

A DECADE OF LIBRARY PROGRESS IN AMERICA.

By WILLIAM WARNER BISHOP.

AMONG the many gatherings of specialists which were held in connection with the Chicago Exposition in 1893 was an International Congress of Librarians. The account of its sessions appeared, in the usual belated manner of government publications, in the Report of the Commissioner of Education some three years later. The American Library Association has just held another similar international congress for the St. Louis Fair. It seems a fitting time, in view of this event, to set forth as well as may be in brief compass the events which have made the ten years which have elapsed since the World's Fair at Chicago a memorable decade in the history of American libraries.

It was a saying of President Garfield's that American education runs too much to bricks and mortar. A biting sting of truth lies in these words, truth which applies but too well to the library world in common with that of education. It is perhaps a national failing to exalt the visible and tangible, and to ignore the subtle and unseen work of culture and study. Undoubtedly the average man will turn to the new buildings which have been reared in this decade for his criterion of progress in library affairs. They form, it must be said, a notable addition to the list of public buildings of merit in the country.

Perhaps it is not too much to say that the modern American library is a new architectural type. Conditions peculiarly our own, many of them the direct result of American innovations in planning library work, have produced a kind of building which is in many respects novel. The college gymnasium and the large library in the hands of our architects have become almost as markedly American forms of building as the sky-scraper and the grain elevator. The demands of the librarian for natural light throughout the structure, for compact storage and at the same time for instant accessibility of his books, for protection from fire and damp, joined with the need of supplying plenty of space for readers, for administration and for those who throng the corridors and desks where books are given out and returned, have resulted in some extremely interesting and beautiful buildings. More and more architects are studying the needs of libraries, and mistakes once made and realized are seldom repeated.

The small library also has furnished in the past decade numerous

opportunities for the designer. Aside from the benefactions of Mr. Carnegie, which are in some respects the most striking event of the past ten years, literally scores of small buildings have been erected by private individuals and by towns. These are coming to form an architectural type fully as distinct as the large buildings. As a rule, of late years these smaller library buildings have taken the shape of a rectangular structure with a central hall, two large front rooms, a delivery desk across the hall and shelves in 'stacks' in the rear on the main floor. A second story usually provides space for additional study and administration rooms. A very large number of memorial libraries of this general type have been erected, particularly in New England. Numerous local and individual variations occur, but a building designed to shelve some ten thousand books so as to be easily reached by any visitor and to afford one attendant a fair view of the main floor has become the accepted type of the small library.

In 1893 there were but three examples of modern library buildings of a size much above the ordinary to be seen in America. These were the Boston Public Library, the Library of Cornell University and the Newberry Library of Chicago. All these are dignified and imposing structures, while the Boston edifice is distinctly one of the foremost public buildings of the country. No one of these buildings has ever satisfied librarians as an ideal, despite their abundant merits. In the past decade a round dozen structures have been reared, which undoubtedly rank as of the first order for size and cost. They are the Library of Congress, the Carnegie Library of Pittsburgh, the Public Libraries of Chicago, Milwaukee, Providence, Newark and the District of Columbia, and the libraries of Columbia, Princeton, New York and Illinois Universities, together with that of the State Historical Society of Wisconsin. Each of these buildings is in itself a notable production; as a group they form a striking testimony to the extent and vitality of the library 'movement' in this country. None of them is without individuality. The reading room of the Library of Congress, the rotunda and impressive south façade of the Columbia Library, the Hall of Fame at the rear of the New York University Library, are characteristic features known to all readers of the illustrated papers. The others offer even more interesting and valuable returns to the student of our architecture and of library problems. The university libraries and that of the Wisconsin Historical Society in particular will repay the most careful examination.

It has been a decade of building, and the end is not yet. The New York Public Library's building now in process of erection is but the largest of scores either planned or under way. For most of this expansion Mr. Carnegie is responsible. There seems to be no limit to his generosity, and with very few exceptions, the money he has given

to libraries has gone into buildings. Mr. Carnegie is a firm believer in the doctrine that the public should support the public library, and he has regularly stipulated that ten per cent. of the amount which he gives for a building should be pledged by the community as an annual appropriation for maintenance. His gifts have gone both to cities already possessing libraries great and small, and to others where libraries must needs be organized to take advantage of his gifts. Exactly what the results of his munificence, aside from the buildings, will prove, it is too early to say. There seems to be very little likelihood of any but good consequences resulting from his wholesale giving.

So much for the 'bricks and mortar.' On the side of library science substantial progress has been achieved. The spirit of cooperation between libraries was never so strong as at present. That spirit which produced 'Poole's Index' has resulted in the current indexing of over two hundred serials of a technical sort in addition to a continuation of this earlier work on the more popular magazines. Far more important than any other feature of the decade has been the adoption of uniform rules for cataloguing by many of the libraries of the country, for the purpose of securing printed catalogue cards from a central bureau. The master minds among librarians since the middle of the nineteenth century have been urging that it was folly for each individual library to reproduce for itself, after the fashion of the middle ages, manuscript catalogue entries for current printed books. A printed book should be catalogued on a printed card which could be bought either with, or at the same time as, the book. So ran the preaching of the idealists. The American Library Association for a time endeavored to do this through its publishing board; later a commercial organization took the work from the hands of the association and continued it for a short time. Both finally dropped the scheme as financially unprofitable. It was reserved for the Library of Congress to take the first effective step toward emancipating the library profession from the ancient bondage of the scribe. First by a series of compromises the libraries of the country, through a committee of their association, adopted a new set of rules for cataloguing. Then the Library of Congress announced that it was ready to sell the printed cards which it makes for copyright books, its other accessions, and such books as it re-catalogues, at the regular price of government publications, *i. e.*, the cost plus ten per cent. This is now being done with great benefit to all concerned. The result has undoubtedly been disappointing to some enthusiasts who had confidently expected that henceforth their catalogues would make themselves. But while the labor of cataloguing has by no means been completely eliminated, the result attained by the use of this printed card is a far finer, fuller and

more perfect card index than any one library could ordinarily afford to make, and that at a cost much less than that of manuscript cards. There is every reason to look forward not alone to a great extension of the present work of supplying printed cards to scholars, bibliographers and libraries, but also to an extension of the scheme in the direction of international exchange or purchase of printed catalogue cards. The beginnings of such a movement are to be seen in the bibliographical labors of the Institute Internationale of Brussels and the Concilium Bibliographicum of Zurich, while the International Catalogue of Scientific Literature for which the Royal Society of London is sponsor is another great step toward international cooperative cataloguing.

Bibliography has received a great impetus in the past decade in America. Among other signs is the inevitable one of an organization. Americans, said Agassiz, when they have anything to do, must have a president, vice-presidents, secretary, treasurer and a constitution. The genial Swiss was right. The Bibliographical Society of Chicago is about to become the American Bibliographical Society. Meantime private and corporate activity has produced some noteworthy bibliographies, of which The American Library Association's 'Guide to the Literature of American History,' Mr. Evans's 'American Bibliography,' the 'United States Catalogue of Books in Print' and the 'American Catalogue' are perhaps the most remarkable. The list might be indefinitely extended. Bibliography, whether seen in the form of the scholarly treatise, such as the catalogue of the Dante collection of Cornell University, or in that of the latest reading list for children, has become a distinct feature of library progress in America.

There has been no small amount of legislation affecting libraries in the period we are considering. This has taken, as a rule, two directions, first, that of laws creating or amending a general act providing for the establishment of libraries, and second, laws establishing library commissions in the several states. The latter feature is the most prominent in the history of the relation of the state to libraries. In 1893 Massachusetts, New Hampshire and Connecticut alone possessed these boards. Now twenty states have established them by statute. Generally these commissions are composed of certain state officials *ex officio* (usually the librarian of the state library and the state superintendent of public instruction) and certain public-spirited citizens who serve without pay. They have a modest sum to be expended in employing inspectors and organizers. In general their work has been limited to helpful suggestion to the libraries of their states, and to the administration of a system of traveling libraries, another new development of the decade. In certain states the commission is empowered to render some small financial support from state funds to

public libraries. The Wisconsin commission has furnished the model which has generally been followed in the west, while the Massachusetts commission has been the type for the eastern states. The western commissions have had somewhat more legal authority, as well as larger sums to expend, and have usually employed more officers than have those in the east. The future will doubtless see an extension of this benevolent state supervision and help. It must be confessed that no other influence has been so potent in the improvement of the condition and administration of the smaller and more backward libraries as these commissions. They have fully justified their right to exist. They have also furthered to a remarkable extent the creation of new libraries in communities not previously possessing them. 'Traveling libraries,' small collections of some fifty books, have been called into being and managed largely through the commissions. These small collections are sent to rural communities, and even to places in large cities where they are desired, are kept for a few weeks, and exchanged for another set. They have commended themselves most highly to those interested in bringing books to people who have few or none.

This leads us naturally to a consideration of what may be termed the missionary spirit in library work. It may be remarked in passing that this seems a peculiarly American development, and that in general a growing consciousness of the possibilities a high and useful service in the life of the municipality has been one of the conspicuous features of the public library movement. The librarian who regards himself as a missionary of the book has been much in evidence of late, and on the whole has been both efficient and sane. The idea that he is a custodian of books merely has ceased in large measure to be the librarian's conception of his office. He is rather a guide and helper to the use of books. "The best that can be said for any book in this library," said an enthusiastic leader in this sort of work, "is that it is entirely worn out, and we must buy two new copies of it." This was in answer to the faint protest of an elder librarian to the effect that children should not be allowed in libraries because they wore out the books by reading them so much. This zeal for helping others to books, to the right books, has resulted in many reforms in the internal arrangement of library buildings and in the relations of the administration to the public. As a rule, the newer libraries are allowing a great amount of freedom in direct access to the shelves on the part of all users of the library. Many of the more recent buildings have been planned so that the visitor may go directly to the shelves, and many of the older buildings have been remodeled to permit this practise. In almost every way this has been a gain. There has come with it no small loss of books, but that loss is insignificant in view of the greatly increased use of the libraries which has resulted from easy personal contact with

books. Most libraries in the future will undoubtedly be planned to permit direct access to open shelves for a great part of their collections. There is, however, a point where this privilege ceases to be of use to the public and to the library, and this fact is now very generally recognized.

Open shelves are but one manifestation of the missionary spirit. Special rooms for children in charge of specially trained assistants are another result of this desire to bring books and people together. The creation of 'children's rooms' has been on the whole a great blessing to libraries. It has drawn away the younger children from the reading rooms and delivery counters, and has perhaps ingrained the reading habit in very many little ones. Certainly the children's room with its cheerful and prettily decorated walls, its low tables and chairs and its tactful, kind, experienced director has proved a boon to countless children into whose homes none of these delectable things enter. This particular form of library work is, however, as yet too young to enable us to judge of its ultimate results.

Another form which the missionary spirit has taken is a closer relation and a more effective cooperation between libraries and schools. The desire for an organization to give opportunity for the public exploitation of this sort of work produced in 1896 the Library Section of the National Educational Association. Not the schools alone, but women's clubs and social settlements, and, in general, all organizations whose members use books in their work, have been brought into friendly relations with the progressive libraries. In short we may safely affirm that public libraries are studying the needs of their communities as never before, and that the somewhat vague notion of aiding the 'public' is fast being replaced by concrete and tangible assistance to organizations and individuals.

The libraries in the large cities have been showing a most decided desire to assist their clients in securing books. To this end the branch library and the delivery station have experienced an almost marvelous development in the past decade. There is hardly a public circulating library of prominence in the country which does not maintain from half a dozen to half a hundred reading-rooms with small collections of reference books, as well as numerous stations for delivery of books from the central library. The largest number of these branch libraries will ultimately be found in New York, where Mr. Carnegie's gifts provide for eighty of these smaller centers in the greater city. Branch libraries have not infrequently been established at the request of large manufacturers or other employers of labor near their places of business, and in some cases the running expenses have been paid by them.

Among librarians also the spirit of mutual helpfulness which has been so characteristic a feature of the library movement in this country

has grown greatly. Library clubs, state associations, interstate conferences and the American Library Association have all grown in membership, while their number has increased threefold at least. Two new schools for training librarians have been established in the past decade, and the older schools have strengthened their curricula and raised their standard for admission. One new journal devoted particularly to the work of public libraries has come into existence.

Any summary of this decade would be incomplete which failed to mention the great additions to American libraries in the shape of special collections or endowments for special purposes. Such gifts as the John Carter Brown Library of Brown University, the Riant collection at Harvard, the Yale collection of Semitic manuscripts, the Dante collection presented to Cornell by Willard Fiske, the Avery Architectural Library at Columbia, the Morgan collection of Vergils and the Garrett collection of Arabic manuscripts at Princeton, and the Ford and other collections of the New York Public Library, are but conspicuous examples of the collector's generosity which has been so prominent a part of recent library history. The man of wealth may easily give money for a building, but the scholarly collector who turns over to a library for keeping and use the result of his efforts of years gives perhaps even more munificently. The libraries of this country are yearly receiving such donations in ever increasing numbers.

It would be a rare and happy fate were the librarians of America able to remind themselves of no great losses from their ranks in the past decade. Such is, unfortunately, not the case. Three of the pioneers in library progress have died during this period. Those who know intimately the history of the library movement will at once acknowledge that in the loss of Wm. F. Poole, Justin Winsor and C. A. Cutter the library world has been sorely stricken. Dr. Poole is remembered by historians and librarians alike for his services to American history and bibliography. Mr. Winsor's achievements as a cartographer, historian and librarian are too well known to need more than mention. Mr. Cutter, whose death occurred only last summer, was not so widely known outside the circle of technical workers. To librarians he was celebrated for a long series of most valuable contributions to the problems of classification and cataloguing, while his personal qualities endeared him to all. That such men were to be found foremost among American librarians is one of the occasions for pride in their calling. Their memory should prove one of the greatest incentives to future workers in their chosen field.

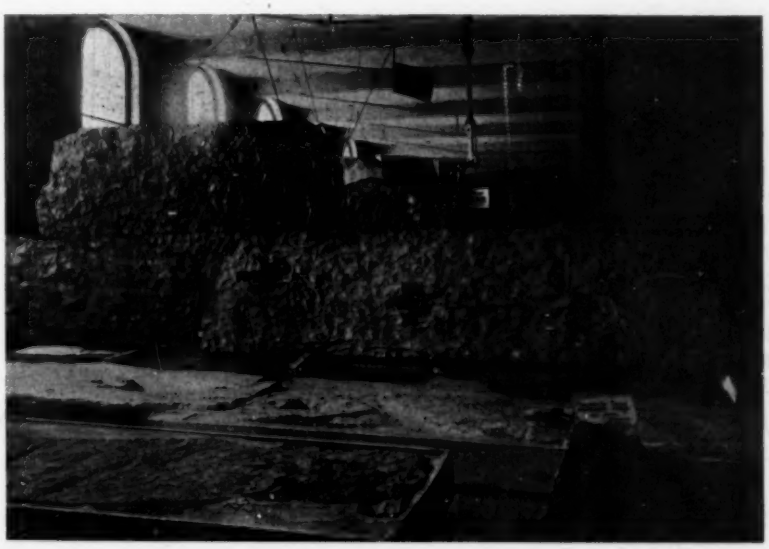
It would be a rash man who should venture to predict the directions of library growth in the next ten years. Certain tendencies, however, may be inferred from the immediate past. It is almost certain that the impetus given to public libraries by Mr. Carnegie will

result in steady growth and an increased efficiency in this field. It is equally certain, I think, that more efficient and widely extended state inspection and advice to libraries are likely to be had in the near future. Library legislation is tending to become more uniform in the several states, and perhaps the enabling acts which now permit public libraries to be supported by taxation may be exchanged for mandatory acts compelling their establishment after the manner of public schools. The greatest internal improvements which can be foreshadowed will probably be the growth of a scholarly spirit among librarians, and an increased emphasis on bibliographical work. A large measure of cooperation in the technical details of library administration and the consequent cheapening of its cost may also confidently be expected. Finally, it is entirely probable that the educational value of libraries in the community will come to be greater both by reason of the conscious efforts of the librarians to increase their efficiency, and by the recognition of those efforts on the part of the public whom they serve.

NATURE'S HIEROGLYPHICS.

By Dr. RICHARD S. LULL,
MASSACHUSETTS AGRICULTURAL COLLEGE, AMHERST, MASS.

ONE of the loveliest parts of all New England is the broad valley of the Connecticut River, of deep human interest because of its having been the theater of many of the conflicts during the struggle for existence between the white settlers and the aborigines, and occasionally one comes across a monument whose inscription tells of the fierce engagements of colonial days. More numerous still are the records of an earlier race, not in this instance of mankind, but of creatures far antedating man in antiquity, which have left involuntary inscriptions on the rocks.



PART OF THE AMHERST COLLEGE MUSEUM.
The long slab shows six successive tracks of a tail-dragging carnivorous dinosaur.

For nearly a century these impressions have been observed by the good folk of the valley, though as many of them had to the uncritical eye the familiar appearance of bird tracks, they were considered as such, and to those who were unaware of their vast antiquity they were undoubtedly of little interest. As soon, however, as they became known to men who could appreciate their full significance, the impressions were at once recognized as being of great scientific interest, and it is to the efforts of the late President Edward Hitchcock, of Amherst College,

that we owe the founding and development of a study which soon rose to the dignity of a science. The interest of President Hitchcock ceased only with his death in 1865, and his tireless energy resulted in the bringing together of a magnificent collection of track-bearing slabs and in the description and publication of more than one hundred species of track-making organisms.

The impressions, while mainly of footprints, also give evidence of dragging tails and other portions of the body or of the armoring and texture of the skin. Other attendant phenomena have left their records also, such as the rainprints of a summer shower, ripple and other beach marks, and the shrinkage cracks which are found in sun-dried mud. These are preserved with wonderful fidelity and minuteness of detail.

Classification of the Tracks.

The footprints may be classified under three groups, according to the mode of progression or the posture of the maker. First the impressions of true bipeds, those whose very bird-like imprints gave the popular name of bird tracks to the phenomena as a whole. Here may be, though rarely, the trace of a dragging tail, but with this exception the hind feet alone leave their record on the rocks.

The second group is as truly bipedal as the first in gait, and the footprint is usually as bird-like as before, but there may occur in addition to an occasional tail trace the impressions of little five-fingered hands placed just in front of those of the feet, while from the rear of the footprint often extends that of a long slender heel. These impressions of the hand and heel were only formed when the creature rested, for, except for differences in shape, the footprint of the moving form can not be distinguished from those of the first group.

The third are the true quadrupeds, not alone in resting posture, but during locomotion as well, in some cases with feet whose impressions are full of character, which gives some clue to their maker's affinities; others slender toed and obscure, whose true relationship with known creatures it is difficult to conjecture.

There remains yet a fourth group of imprints, which, while evidently formed by living organisms, are certainly not those of vertebrates or backboned animals, and, if one may judge from their appearance, may have been made by creeping worms or by crab- or centipede-like creatures or possibly by insects.

Interpretation of the Footprints.

Even to the layman the mounted skeleton of an extinct animal is something tangible which the imagination can readily clothe with flesh and endow with life; but the first impression which the mind receives of the footprints is like that of an ancient inscription whose characters

are those of an unknown tongue, the meaning of which is an enigma unless one has the key. The earlier students attempted to decipher the footprints by comparing them with animals then known, with the

RESTORATION OF THE NEW WINDSOR DINOSAUR.
The probable maker of the tracks on the Middletown slab.

result that they thought they recognized the impressions of batrachians, reptiles, birds and mammals; in fact every group of creatures which were

THE MIDDLETOWN SLAB COVERED WITH THE FOOTPRINTS OF CARNIVOROUS DINOSAURS.
The tracks are in high relief.

capable of making tracks. It will be seen at once that the only true key to these nature's hieroglyphics would be actual skeletal remains associated with the footprints or, if found elsewhere, in beds of equivalent age.

In 1818 the first fossil skeleton found in the valley was discovered at New Windsor, Conn., and later, just before the civil war, another was brought to light at Springfield, Mass. These, while fragmentary, were recognized to be reptilian in character, and when the latter specimen came to light it at once cast a grave doubt upon the correctness of the accepted interpretations. Hitchcock himself speaks of these remains as being 'those of fair representatives of the creatures which made the tracks.'

It was not until nearly the last decade of the nineteenth century that further excavations at New Windsor, which resulted in the finding of two more specimens, enabled Professor Marsh, of Yale University, to restore the creature and to give us an adequate knowledge of its organization and affinities and thus to furnish the first true key to the correct interpretation of the footprints. Further discoveries abroad, but more especially in our own great west, have given us a very complete knowledge of the magnificent race of reptiles to which the Connecticut Valley forms belong.

During the Mesozoic age, comparable to the medieval times in human history, reptiles were the dominant forms; they occupied the places in the economy of nature to-day taken by the birds and beasts, both animal and plant feeding, as well as by the whales and other denizens of the air, earth and sea; but among the great reptilian assemblage none were more varied in size, aspect and habits than the dinosaurs or terrible lizards, at that time the peers of the animal realm. These creatures are first known from the rocks of the Triassic, the earliest of the three periods into which the Mesozoic age is divided, reaching their millennium as a race during the close of the second or Jurassic period, at which time they attained their greatest profusion in numbers and their highest development in point of size. In the strata formed toward the close of the Cretaceous, or final period, the dinosaurs reach their maximum of specialization, developing forms among the most weird, grotesque, as well as the most terrifying, the world has ever known. This marks the decadence of the race, the prelude to its extinction, for in the immediately overlying rocks of the Tertiary period not the least vestige of a dinosaur has been found.

At least three great orders of Dinosauria are recognized, of which two, embracing the land forms, were represented in the footprint fauna, while of the third, gigantic quadrupeds, whose vast bulk has won for them the name of *Cetiosauria* or whale lizards, plant feeding and semi, if not wholly, aquatic in their habits, there is not a trace.

The remaining orders were sharply differentiated in their habits of feeding, the one being carnivorous, the other herbivorous, in diet; and while the more primitive members of both orders were quite similar, such is the influence of habit upon a race that their evolution

was a divergent one, the ultimate representatives differing widely from one another in bodily contour, form and structure of the teeth, and in mode of progression.

The Carnivorous Dinosaurs.

The earliest and most primitive of the carnivorous dinosaurs were those already alluded to as having been found at New Windsor and Springfield in the Connecticut valley. These creatures were somewhat lizard-like in general aspect, with the fore limbs fitted for grasping, while the much larger hind limbs, which were very bird-like, were used for locomotion. A study of the skeleton seems to indicate that the center of gravity came just about the region of the hip socket, so that the weight of the tail counterbalanced that of the forward portion of the body, thus making progression upon the hind limbs the only probable gait. The grasping hand, the structure of which is ill-fitted for locomotion, gives color to this assumption.

An extremely interesting slab in the Amherst College Museum, whose upper surface has been worn smooth by the feet of nearly two generations of men, for it did duty as a paving stone in the streets of Middletown, Connecticut, for more than fifty years, bears on its under surface in high relief numerous perfect tracks, in this instance not the footprints themselves, but the natural casts of the feet which made the prints, formed when the incoming tide deposited its load of sediment over the place where the creatures had walked. This *bas relief*, for such it may be called, admits of the following interpretation: that the makers of the tracks were true bipeds, as all of the casts are those of hind feet, moderately long of limb, walking with alternate steps, with compact bird-like feet, having three toes directed forward with moderately pointed claws, and evidently another directed backward whose claw only occasionally touched the ground. There is no sign of a caudal trace, showing that the tail if present was used only as a counterpoise. The size, length of limb, number and proportions of the toes, and the absence of hand and tail impressions, together with the fact that they are among the most numerous of the tracks, the makers of which would in consequence be among those most likely to be preserved as fossils, all point conclusively to the New Windsor dinosaur as the creature whose existence is thus recorded.

The carnivorous dinosaurs followed at least two lines of evolution, the more conservative of which simply increased in size and in consequent strength and ferocity throughout their racial career. In this group, perhaps the most remarkable feature is the constantly increasing disparity of size between the fore and hind limbs, for in the later forms the arms were so absurdly small that it is difficult to conjecture their use. As the fore limbs decreased in size, the hind legs, in addi-

tion to their duty of supporting their owner's weight, had to assume the grasping function as the hand relinquished it, and the claws became in consequence great talons, differing thus markedly from those of the earlier types.

One seems, therefore, justified in interpreting a second group of tracks, much larger than those of the Middletown slab, sharp clawed and with a very narrow sinuous tail trace, as having been made by a dinosaur of this group. If one should picture an animal about twenty feet in length, weighty in build, with talon-like hind claws, and therefore with small fore limbs and with a fairly erect posture so that the tip of the rather short heavy tail touched the ground, one would have a fair notion of this the maximum form, both in size and in degree of specialization of the Connecticut valley carnivores.

The other group of carnivorous dinosaurs were of a very different sort, always retaining their agility and the grasping power of their fore limbs, but not increasing very materially in bulk. A beautiful example of this race from the Jurassic beds of Wyoming has recently been mounted at the American Museum of Natural History, New York, and has been given the name of *Ornitholestes,* the bird robber, in allusion to its supposed habits. It is a slender animal with an extremely long tail. The hind limbs are fitted for locomotion *par excellence,* while the fore limbs are more slender with but three very long fingers in the hand, admirable for grasping elusive prey.

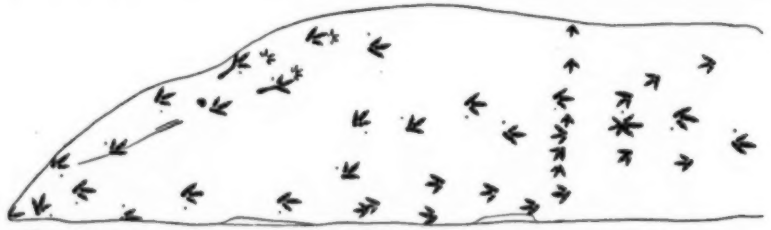
In studying the footprint slabs one frequently comes across some very small impressions, hardly exceeding three inches in length, three-toed, with no indication of a grasping claw behind, nor of a tail trace. One might be apt to attribute these little footprints to the young of the larger species until one notices the great interval between the successive tracks, a distance six to eight times the length of the foot itself. This of course gives evidence of extremely long limbs, so that the name of *Grallator,* he who walks upon stilts, which has been given to this group, is not inapt. While no skeletons are known from the same horizon with which the footprint may be compared, it seems safe to consider it one of these aberrant carnivores, of very slender build, agile, and of habits possibly similar to those of the wading birds.

It is but just to the earlier naturalists to say that we have no absolute proof that *Grallator* was not a true bird, but that it was seems doubtful, as the foot agrees in structure with that of known dinosaurs, and birds are totally unknown from so remote a period.

Herbivorous Dinosaurs.

Plant feeding dinosaurs are known by their skeletal remains only from the Jurassic and Cretaceous periods, but that they existed during the earlier Triassic seems indubitably certain from the fact that their

HERBIVOROUS DINOSAURS OF PRIMITIVE TYPE RESTORED FROM THE DATA FURNISHED BY THEIR FOOTPRINTS.



FOOTPRINTS OF AN HERBIVOROUS DINOSAUR SHOWING WHERE THE ANIMAL RESTED.
Drawn from a slab in the Amherst College Museum.

wide variation and distribution in the Jurassic implies an ancestry in the earlier period, and also that their footprints on the Triassic sandstones are unmistakable.

The more primitive herbivores resemble their carnivorous allies in general contour and in mode of progression, though differing in certain internal characters and in the teeth, these being necessarily changed to enable their owner to chop or grind up the plants upon which it lived. The rear part of the jaws became, in the later forms, veritable magazines of teeth, the latter replacing one another in vertical succes-

BEACH WITH TIDE MARK AND THE TRACKS OF AN HERBIVOROUS DINOSAUR GOING DOWN TOWARD THE WATER.
Photographed from a slab in the Amherst College Museum.

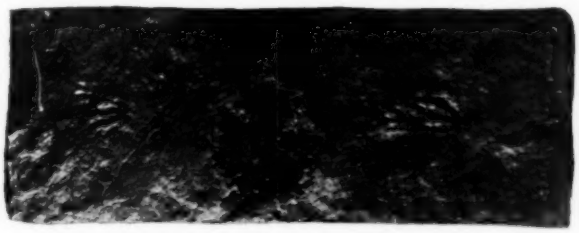
sion, a new one being always ready to take the place of one lost or worn out in service. The front part of the mouth bore a few teeth in the earlier types, but these soon gave way to a horny upper and lower beak, turtle-like in aspect, probably used for cropping succulent herbage.

The hind feet were still very bird-like, especially in the less specialized forms, but with blunted claws, while the hand always retained its five fingered condition with short rounded nails. The fore limbs could always be used for the support of the forward parts of the body, though perhaps not always for food gathering. It is extremely doubtful whether any of the earlier plant feeders ever walked on all fours, though in the later forms, owing to the great weight of armament which they carried, a four-footed gait was rendered necessary. The herbivorous dinosaurs proved a more plastic race than their carnivorous brethren, and towards the close of their career there arose among them the remarkable types, already alluded to, which marked the decadence of the group.

In the footprint fauna the herbivores were all true bipeds, but did occasionally impress the hand, including thus all the footprints of the second or occasionally quadrupedal group, and probably some of the first as well, though this is open to question.

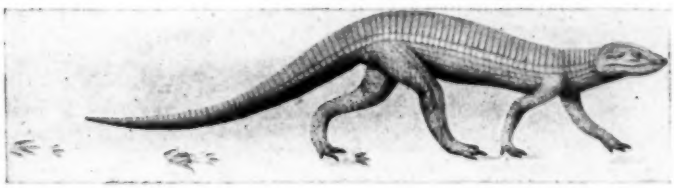
The footprints give us thus our first recorded evidence of herbivorous dinosaurs in the Triassic, which will some day probably be verified by the finding of their bones.

One extremely interesting specimen in the Amherst collection bears in all about fifty impressions, most of them made either by the same animal walking back and forth along the beach or by several of approximately the same size. In one of his journeys the creature slows down as shown by the fact that the tail begins to drag, whereas it had been



FOOTPRINTS OF A SMALL QUADRUPEDAL REPTILE, *Stegomus*, WHOSE RESTORATION IS SHOWN.

held out stiffly behind to counterbalance the weight of the body. Then the animal stops and comes down on all fours impressing the little hands and long heels, then, having satisfied its purpose, it rises again to its hind feet, touching one hand and the tail tip once more to the ground in regaining its balance, and then goes on its way. This single slab gives us thus a knowledge of the creature's size, proportions, gait, resting posture, feeding habits, for the little hand with its nail-like claws could never have been used for grasping prey, and finally of the texture of the skin on the soles of the feet with creases between the joints, like those of the human fingers, and tiny granulations, like



RESTORATION OF *Stegomus*, A DISTANT ALLY OF THE MODERN CROCODILES BUT WITH HIGH STILTED LIMBS.

mustard seed covering the entire surface. Footprints of this character are very common and indicate dinosaurs of rather light build, ranging in size from three and a half to seven feet.

One of the most remarkable of all of the footprints measures twenty inches in length, with four toes directed forward bearing broad rounded claws. The foot was bear-like, in that the entire sole and heel rested upon the ground and bore around its margin a broad web-like flange of skin, the probable function of which was to prevent the creature

from sinking too deeply in the soft mud. The hand very rarely impresses, and but one instance is known of a dragging tail. What this uncouth brute looked like, one can not even imagine, for no skeletal remains are known which it in the least resembles.

One very numerous group of large bird-like tracks unaccompanied by hand or tail impressions seems from the blunted claws to have been those of plant feeders, but of this we can not be sure, for the condor of the Andes is also blunt clawed, and suggests the possibility that the makers of these tracks may also have been carrion feeding, which would place them among the carnivores. Certain it is that they were dinosaurs, and among the largest of the valley forms, though probably but half the bulk of their successors in the later rocks. One huge footprint from Northampton, Mass., measures twenty inches in length and holds four quarts of water.

Quadrupeds.

There must have been quite a host of quadrupedal forms in the Triassic days, mainly of small size, but while they were probably of amphibian or reptilian origin nothing was really known of them until very recently. Professor Marsh found, some years ago, the remains of one animal, but unfortunately only the impression of the armor of the back remained, and, as the limbs were lacking, nothing could be learned of its probable footprints. A second specimen has just been brought to light, found in the village of Longmeadow, Mass., sufficient of which is preserved to show that the creature was long of limb and was probably a rapid runner. From its size and proportions, it corresponds very closely with one of the most numerous of the quadrupedal tracks. The Longmeadow specimen belongs to a group of primitive crocodile-like reptiles, to which Professor Huxley has given the name of *Parasuchia*. The footprints are small, but with a long interval between the successive tracks, with sharp claws, with four toes on the foot and five on the much smaller hand. Thus far only may we interpret the quadrupedal footprints with any assurance, for beyond this we are in the realm of almost pure conjecture, which in footprint interpretation has thus far nearly always proved wrong.

To summarize briefly, the footprint fauna contains amphibians, reptiles, and possibly birds; of the first we as yet know nothing, but we may be reasonably sure that they occurred; of the reptiles we have identified numerous dinosaurs, representatives of both great land-inhabiting orders, and we have also found indications of early crocodile-like forms. Other reptilian orders were doubtless present, but what they were we have as yet no means of knowing. Finally the only creatures which could have been birds could as readily have been dinosaurs and such in all probability they were.

Occurrence and Means of Preservation.

Fossil footprints have been found in various parts of the world, as in England, Germany, France, and, in our own country, in the Grand Cañon of the Colorado, as well as in association with Jurassic dinosaurs in the northwest; but it is in the valley of the Connecticut and in rocks of the same formation in New Jersey that they occur in an abundance and perfection of preservation which is unrivaled elsewhere.

In this region sandstone beds of great thickness occur which every now and then exhibit impressions with generally something of an interval between the track-bearing layers.

Geologists have been led to suppose that the broad valley of the Connecticut was during Triassic times a tidal estuary extending from the village of Northfield, Mass., to New Haven, a distance of one hundred and ten miles, with an average width of twenty miles. In places in this estuary were mud flats, some well out in the ancient bay, others nearer the shore, which were left bare by the receding tides. Here the animals loved to congregate, possibly they came for food, but it seems more likely that the dinosaurs here assembled at certain seasons for mating as the seals do in the Alaskan rookeries.

The means of preservation were threefold, of which the first was the fierce heat of a tropical sun, for plant remains indicate that such climatic conditions prevailed, while the second and third are really attributable to one cause, volcanic activity. This resulted in the formation of the Holyoke and Mt. Tom ranges and in broad lava flows. Upon these sheets the sand and silt were deposited, forming thus the tidal flats where the creatures congregated. The heat of the cooling lava added its baking effect to that of the sun, while the decomposing lava liberated an iron cement which completed the task of solidifying the overlying material into rock.

The impressions made when the tide had ebbed were thus somewhat hardened before the incoming flood bearing its burden of sediment gently buried the traces without the least injury, thus preserving for our enlightenment these monuments of the past.

THE PRESENT PROBLEMS OF PHYSIOLOGICAL CHEMISTRY.*

By RUSSELL H. CHITTENDEN,

DIRECTOR OF THE SHEFFIELD SCIENTIFIC SCHOOL OF YALE UNIVERSITY.

IN considering a proper presentation of the subject assigned me, I am impressed with the influence which a man's own field of work and his own line of thought will naturally exercise upon his point of view. It may be questioned whether his judgment can be wholly trusted, whether he will not, in fact, unconsciously it may be, give a dwarfed or one-sided presentation of the subject from a natural habit of looking at things in their bearing upon the line of work and thought in which he himself is personally most interested. While this may not be wholly undesirable, still of greater advantage will be a brief but judicious presentation of all the more important problems that confront the physiological chemist of the present day, but whether this can be done satisfactorily in the time allotted is very questionable. However, the effort will be made to emphasize, so far as the time will allow, what to the writer seem the more significant and far-reaching problems in physiological chemistry that call for speedy solution.

Of fundamental importance is the question, what is the exact chemical constitution of proteid matter? The basis of all cell life, the most complex molecule that enters into the structure of the living organism, proteid or albuminous material holds a peculiar position. A labile molecule, it is easily prone to change, and its many decomposition products confront us on all sides in our study of life's processes. Yet to-day, in spite of all that has been accomplished, even with the brilliant work of Kossel and Emil Fischer, we still lack adequate knowledge of all the groups and radicles that are combined in this atomic complex.

In the study of metabolism and nutrition, both in health and in disease, in our conception of the anabolic processes of life, in our theories regarding the chemical relationships of the varied katabolites floating about through the organism and in many other connections, we need for our guidance a full knowledge of the chemical nature of this most important class of substances. Thanks to the work of many brilliant investigators, our knowledge is progressing and broadening, but we still lack that comprehensive understanding of the inner struc-

* Read before the Section of Physiological Chemistry in the International Congress of Arts and Science held at St. Louis, September 22, 1904.

ture of the molecule that would serve to illuminate our field of vision and give us a clear conception of the chemical constitution of this group of physiologically important ground substances in living protoplasm.

As is well known, the proteid bodies constitute a group of widely divergent substances. Of these, the basic protamines are undoubtedly the simplest and lowest in the scale, and it is quite probable, as suggested by Kossel, that these substances constitute the nuclei of all proteids. The protamines differ somewhat among themselves, but as a group they are characterized by their high content of diamino-acids, especially arginin. Thus, salmin yields on decomposition 84 per cent. of arginin, clupein 82 per cent., cyclopterin 62 per cent., and sturin 58 per cent.* Sturin also contains 13 per cent. of histidin and 12 per cent. of lysin, while the other protamines appear to contain no diamino-acids aside from arginin. Further, the protamines contain diamido-valerianic acid, monoamido-valerianic acid, tyrosin or p-oxyphenyl-amidopropionic acid, skatolaminoacetic acid, a-pyrrolidincarbonic acid and serin.† Salmin‡ has also been shown to contain alanin, leucin, probably also phenylalanin and aspartic acid.

If we pass from the simplest of the proteid bodies to the most complex, as the nucleins, we find present in the latter not only arginin, lysin and histidin, but, in addition, such bodies as thymin, the purin bases, leucin, aspartic and glutamic acids, two sulphur-containing groups, furfurol-forming groups, pyrrolidincarbonic acid, a skatol-forming group, phosphoric acid, amidovalerianic acid, a levulinic acid-forming group, glycosamine, pentose, uracil and probably phenylamido-propionic acid.§ In the histon from the nucleohiston of the thymus, we find in addition to the hexone bases and the monoamido-acids characteristic of the ordinary albuminous bodies such substances as glycocoll, cystin and alanin.

These statements, brief and incomplete though they are, will serve to illustrate the complexity of the proteid molecule, and at the same time they indicate the close genetic relationship which unquestionably exists between the varied members of this large group of substances. There is no doubt that Kossel and his co-workers in their efforts to unravel the constitution of the protamines are pursuing a wise course in paving the way for a comprehension of the exact nature of the more complicated proteids. There is no doubt that the protamines of one

* Kossel and his students. See Kossel and Dakin, 'Ueber Salmin und Clupein,' *Zeitschrift für physiologische Chemie*, Band 41, p. 407.

† Kossel und Dakin, 'Beiträge zum System der einfachsten Eiweisskörper,' *Zeitschrift für physiologische Chemie*, Band 40, p. 565.

‡ Abderhalden, 'Die Monoaminosäuren des Salmins,' *Zeitschrift für physiologische Chemie*, Band 41, p. 55.

§ See Kossel, 'Ueber den gegenwärtigen Stand der Eiweiss Chemie,' *Berichte der Deutschen Chem. Gesellschaft*, Jahrgang 34, p. 3214.

type or another are integral parts of every proteid molecule, and when their chemical constitution is made quite clear, much will have been accomplished toward a fuller understanding of the more complicated forms.

It needs no imagination to foresee what a full knowledge of the chemical constitution of all types of proteid matter will mean for the physiologist and physiological chemist. Much that is now cloudy and uncertain in our understanding of cell and tissue metabolism, in our comprehension of nutritive changes in general, of digestive proteolysis and of intracellular autolysis, will become clear as crystal. The problem, however, is not a simple one, but is exceedingly complex, for it is to be remembered that just as the individual proteids differ from each other in superficial reactions and characteristics, so do they undoubtedly differ in their inner structure. Hence, we must expect to find variations in the make-up of the individual molecules, and it is one of the most important problems of to-day to ascertain the nature of these chemical variations, to recognize the individual groups that give character to the molecules and to learn how these groups are bound together to make the typical proteid of this and that tissue or organ. The solution of this problem promises much for the advancement of physiological chemistry, but it holds out the promise of even more for the good of physiology in general, since there is bound up in the chemical structure of the proteid molecules a full and complete explanation of tissue changes, and of many metabolic phenomena which to-day are as sealed volumes.

The development of our knowledge regarding the cell as a physiological unit has led to a fuller recognition of the importance of discriminating between the primary and secondary cell constituents. As a result, the physiological chemist has come to realize the necessity of more exact knowledge as to the nature and distribution of the primary components of cells, because of the bearing this knowledge may have upon the general question of how far the lines of chemical decomposition characteristic of each group of cells are dependent upon the character of the anabolic processes by which that particular cell protoplasm is formed, and how far the peculiar katabolic or retrogressive changes of that group of cells are due to outside influences, exerted by specific nerve fibers, or by the character of the blood and lymph stream. The physiological chemist would know whether the secret of glandular secretion, of tissue changes, of metabolic activity, is to be found in the particular forms of protoplasm that enter into the structure of the component cells, whether it is associated in any way with some inherent quality of the primary cell constituents.

There is something marvelous in the unerring certainty with which a given group of cells performs its work, never deviating a hair's breadth

from the beaten course, and turning out year after year a definite line of products for the specific purpose in view. Why is it that the epithelial cells of the salivary glands always manufacture mucinogen and ptyalin; the gastric gland cells pepsinogen, renninogen and hydrochloric acid; the cells of the pancreas trypsinogen and steapsin; the hepatic cells bilirubin, biliverdin and the specific bile acids; the cells of the thyroid iodothyrin, and the cells of the adrenals epinephrin? Essentially the same blood and lymph bathe all these cells with a like nutritive pabulum, and yet each group of cells performs its own line of work, never going astray, in health, and never even temporarily producing a product which rightfully belongs to the other class of cells. Are we to suppose that all these varied products are manufactured from the same cell protoplasm, from a common stock, that each one owes its origin to some particular force controlled by extra-cellular influences, each group of cells being made to manufacture a given product out of the same mother substance? Or, on the other hand, are we to assume that each group of cells, as it is developed, has as a birthright the quality of producing from its particular protoplasm a certain line of products, simply because of the peculiar chemical nature or constitution of that protoplasm?

In other words, do all the intricacies of cellular activity depend primarily upon the character of the anabolic processes by which that protoplasm is built up out of the food materials by which the cells are nourished? It may be just as difficult to explain why and how the cells are able to manufacture a specific protoplasm out of a common pabulum, but the main problem which confronts us is surely capable of being solved. We need to know how far the primary cell constituents of different groups of cells, of the different organs and tissues are similar or unlike each other. If it is shown that the primary cell constituents differ for each glandular organ and tissue, that each group of individualized cells has a protoplasm characterized by some specific feature, then we shall have reason to believe that the anabolic processes are as much, if not more, responsible for individuality of function than the katabolic processes. We may conceive of all protoplasm being built, so to speak, on a certain general plan of structure, but with side chains of varying nature, and that these side chains determine in a measure the character of the katabolic or alteration products that result from the natural activity of the cell protoplasm. In other words, if this conception be true, it is the chemical constitution of the cell protoplasm that is primarily responsible for the character of the changes that take place in all active tissues and organs. The extent of oxygenation as influenced by the circulating blood, the direct and indirect influence of various nerve fibers, etc., may all act as modifying agents, but only to the degree of accelerating or inhibiting the rhythmical process which

travels along a certain definite channel because of the peculiar chemical nature of the cell protoplasm. Once started, the process of katabolism takes a definite course, with formation invariably of the same products, because that particular cell protoplasm, owing to its peculiar make-up, tends to break down along certain definite lines of cleavage, as it were, and so the products split off are always the same.

We already have considerable knowledge which tends to indicate that the cells of individual organs and tissues have a certain individuality as regards their primary components, notably in the nucleoproteids present, but our knowledge is by no means complete enough to permit of broad generalization. The problem is an interesting one, and permits of a definite answer by the application of thorough and persistent investigation.

As an allied question, more or less in harmony with what has just been said, reference may be made to the part which ferments and enzymes possibly play in initiating and carrying forward tissue changes, as well as the metabolic changes that occur in glandular organs. Ferments have come into such prominence of late years as responsible agents for so many transformations, that we may well query whether their influence does not extend far beyond the limits originally assigned to their field of activity. The discovery of oxidases and the part which these agents may play in tissue changes, the undoubted existence of ferments in such glands as the thymus, suprarenal, spleen, etc., by which the recently studied autolytic changes in these glands are produced, raise the question whether ferments or enzymes are not far more largely responsible for the many transformations that take place in active tissues than has been hitherto supposed. Consider for a moment the peculiar products which result from the self-digestion (autolysis) of many of the glands so far studied. Note how the nucleoproteid of the thymus, for example, breaks down, yielding xanthin and a little hypoxanthin, together with uracil, but no guanin, adenin or thymin.* How the adrenal nucleoproteid likewise yields by autolysis considerable xanthin, but only traces at the most of the other alloxuric bases (Jones). By the self-digestion of the spleen, guanin as well as hypoxanthin is conspicuous, but it is a noticeable fact that in the autolysis of the thymus, for example, there is no appreciable amount of leucin to be detected, thus indicating that the above autolytic changes are not due to any ordinary proteolytic enzyme, but to some peculiar enzyme which acts directly and solely upon the nucleoproteids, splitting off certain of the contained alloxuric groups. In harmony with this view, Jones has just announced the presence in the pancreas, thymus and adrenals, of an enzyme to which he gives the name of guanase, which has the power of transforming guanin into xanthin. The same

* Jones, 'Ueber die Selbstverdauung von Nucleoproteiden,' *Zeitschrift für physiologische Chemie*, Band 42, p. 35.

investigator also claims the presence in the spleen of a related enzyme, called adenase, which transforms adenin into hypoxanthin. The inference is that in many glands and tissues there are specific enzymes, as yet undiscovered, which may be responsible for at least some of the transformations known to occur there.

That autolysis may be a possible explanation of the process of animal metabolism has been suggested by Levene* and also by Wells.† It has been clearly indicated by such able workers as Salkowski, Jacoby and others, that practically all animal cells contain within themselves ferments or enzymes that are capable, under suitable conditions, of digesting or breaking down the cell contents by a process similar to ordinary proteolysis, and it may perhaps be assumed that all active cells carry forward their ordinary metabolic processes by the agency of these intra-cellular ferments. Moreover, it is not inconceivable that ferments or enzymes of several kinds may exist side by side in a given group of cells, just as they are known to exist in the pancreas, by which we might infer the possibility of a series of transformations taking place at essentially the same time, through the harmonious action of a row of enzymes physiologically quite distinct.

Further, the recently discovered reversible action of enzymes, on which we have at command so much valuable work, suggests the possibility of a maintenance of cell equilibrium through this peculiarity of action, thus affording a tangible explanation of the means by which intra-cellular nitrogenous or proteid equilibrium is maintained, the various cells of the body building up or breaking down the proteid matter of their own tissues as circumstances require. If these ideas are true, then our conception of ferment action must be considerably broadened, and we have before us the possibility of explaining many of the phenomena of tissue metabolism by the action and interaction of intra-cellular enzymes. This is a problem well worthy of broader study, with a view to the elucidation of the general laws that govern tissue changes in general. In this connection we also have suggested the possibility of interaction of another kind, viz., that interdependence of one tissue or gland upon another for the full development of its functional activity, as illustrated by the part played by the enterokinase of the intestinal glands in the development of an active trypsin from the zymogen of the pancreatic cells, and by the action of the internal secretion of the pancreas upon the inert constituents of the muscle to develop in the latter an active glycolytic enzyme. How far this general principle extends in the metabolic phenomena of the body is entirely problematical, but merits careful study. Here, then, we have an

* 'Die Endprodukte der Selbstverdauung tierischer Organe,' *Zeitschrift für physiologische Chemie*, Band 41, p. 393.

† 'On the Relation of Autolysis to Proteid Metabolism,' *Amer. Journal of Physiology*, Vol. 11, p. 351.

added field of inquiry, worthy of careful consideration, if we are to possess a clear understanding of nature's processes.

Between the animal and the vegetable cell certain sharp lines of distinction are frequently drawn. Physiologists are wont to believe that the processes characteristic of the cells of animal tissues and organs are essentially destructive, *i. e.*, that they are principally katabolic, while in vegetable tissues, on the other hand, constructive processes are very conspicuous. In no way is this better illustrated than in the prevalent opinions regarding the parts played by the two classes of cells in the metabolism of proteid matter. We are accustomed to think that all proteid matter has its primary origin in the synthetical power of the vegetable cell, aided by its contained chlorophyll and the beneficent action of the sun's rays. The animal cell, on the other hand, can merely transform and reconstruct the various proteids furnished by the vegetable world, being without power to manufacture proteid matter *de novo* out of the simple groups and radicles which the vegetable cell utilizes so rapidly. In ordinary proteid katabolism, the various nitrogenous decomposition products are presumably all converted into urea and allied substances adapted for excretion. If, however, there is reversible ferment or enzyme action in the animal body, why may there not also be power to utilize, in some measure at least, the crystalline nitrogenous bases and amido-acids so abundantly formed in trypsin proteolysis, for the construction of fresh proteid matter? One may well query, considering the vigor of the proteolytic action of the enzymes poured into the alimentary tract, whether all these nitrogenous waste products represent just so much lost energy in their production and a further loss of energy in their immediate excretion from the body. In harmony with the 'luxus consumption' theory we may assume wisdom and ultimate gain in this speedy decomposition of excessive proteid foods in the alimentary tract, but the argument is not very convincing. Why may not animal cells, or the animal body as a whole, build up proteid matter out of simple nitrogenous compounds analogous to the action of plant cells? Loewi* has indeed experimented in this direction and states that the biuret-free end-products resulting from the proteolysis of ordinary food albumin can be utilized by the animal body for the maintenance of nitrogenous equilibrium, etc., equally well with the common proteid food-stuffs. His conclusions, however, have been called in question by other investigators, notably by Lesser† whose experimental data failed to confirm the above conclusion.

The problem, however, is an exceedingly important one. If the animal body has no power of utilizing the varied nitrogenous com-

* 'Ueber Eiweissynthese im Thierkörper,' *Archiv für exper. Pharmakol. u. Pathol.*, Band 48, p. 303.

† 'Ueber Stoffwechselversuche mit den Endprodukten peptischer und tryptischer Eiweissverdauung,' *Zeitschr. für Biologie*, Band 45, p. 497.

pounds of simple constitution formed in the gastro-intestinal tract by the digestive enzymes; if there is a complete lack of ability to construct new proteid matter out of these simple decomposition products, then surely we must inquire what is the real purpose of their formation? It is true that, with the limitations of our present knowledge, it is difficult to see why if digestive proteolysis has for its sole object the conversion of the proteid foods into forms suitable for absorption there should be any considerable breaking down of proteid beyond the proteose or peptone stage, since the latter bodies would seem to be most easily adaptable for transformation into the proteids of blood, lymph and tissue. On the other hand, it is well known that the proteid of the food is possessed of a physiological and chemical nature quite different from that of the proteid in the blood and tissues of the feeding animal, and it is quite conceivable that a synthetical process might be essential—in some degree—for the manufacture of the specific proteids called for by the blood and tissues of that particular species or individual. The question is one that demands careful consideration and thorough investigation, for it touches upon a chapter in nutrition on which we have at present very little satisfactory or convincing knowledge.

In this connection we may call attention to another problem, somewhat far reaching, but suggested by one of the preceding paragraphs, viz., the possible physiological action of the many katabolites, or decomposition products resulting from tissue changes throughout the animal body. In vegetable tissues, many of the nitrogenous products common to these structures are endowed with marked physiological power, as witness the vegetable alkaloids and the non-nitrogenous bodies like salicin, digitalin, picrotoxin, etc. Years ago, physiologists recognized that some of these nitrogenous bodies present in animal tissues did have a distinctly toxic action when introduced directly into the circulation, and hence they were frequently called animal alkaloids, but our knowledge upon these points is exceedingly obscure and indefinite. When we take into consideration the large number of nitrogenous products formed and present in the various tissues and organs of the body, products of proteolysis and of tissue changes; when we consider how these products circulate through the organism, in blood and lymph; how they come in more or less immediate contact with the different cells of the body prior to their decomposition or elimination, we can not avoid being impressed with the part they may play in stimulating and modifying tissue or other changes.

The significance of this suggestion is made all the more potent by the knowledge recently acquired concerning several of the internal secretions of the body and the powerful physiological influence exerted by their components. Where can be found a more active physiological agent than the blood-pressure raising constituent of the adrenals, the

epinephrin? Where is there a more active agent in modifying the nutritional processes of the body than the iodine-containing constituent of the thyroid, the iodothyrin. These may truly be counted as representing a type of substances manufactured or secreted primarily for the physiological effect they are capable of exerting; but what about the host of other substances present in the body, many of them simple products of katabolism? May they not have some marked physiological property that if known would serve a sufficient excuse for their formation? Or, may they not possess some hidden or obscure property which if once understood would make clear a secondary or subsidiary function of no small import for the maintenance of physiological equilibrium, or for the welfare of the body? Many suggestions and some facts present themselves, illustrating how direct and indirect influences may be exerted, all pointing toward the harmonious action and interdependence in function of many of the substances formed in the body. Some, however, undoubtedly have more or less of a toxic action, especially when formed in excessive or undue amounts. Thus, the alloxuric bases seemingly cause fever when injected into the circulation or taken per os,* and according to the recent observations of Mandel† there is a very striking relationship between the quantity of alloxuric bases eliminated in the urine and the temperature of the body in cases of aseptic fevers, indicating that these substances, with possibly other incomplete products of tissue metabolism, are important factors in the production of febrile temperature. We may confidently expect that a thorough study of the physiological action of all the varied katabolic products formed in the body will result in a decided expansion of our knowledge regarding the part these substances may play in normal and abnormal metabolism, and in nutrition in general.

Just here, reference may be made to the many problems in the broad field of nutrition that confront the physiological chemist of the present day. The maintenance of life on a sound physiological basis is one of the practical problems in physiological chemistry, and its solution is not yet attained. We need fuller knowledge regarding the part played by the different nitrogenous food-stuffs, the relative physiological value of animal and vegetable proteid, the relative value of fats and carbohydrates as nutrients aside from their different calorific power, and by no means least a fuller and more accurate knowledge of the true physiological needs of the body for proteid foods. Our present dietetic standards are absolutely false and valueless. Our present conception of the physiological needs of the body is altogether faulty and distorted. Our ideas of the rate and extent of proteid metabolism

* See Burian and Schur, *Archiv für die gesammte Physiologie*, Band 87, p. 239.

† 'The Alloxuric bases in aseptic fevers,' *Am. Journal of Physiology*, Vol. 10, p. 452.

necessary for the maintenance of health and strength are crude and inexact. We place the nitrogen requirement of the healthy man at an absurdly high level, apparently because observation has shown that man is disposed to consume an equivalent in proteid food per day. We need to ascertain by scientific experiment how far such standards are justified; to determine by definite analysis the amounts of nitrogen actually required to maintain nitrogen equilibrium and keep up bodily and mental vigor. Upon the physiological chemist of the present day rests the responsibility for the establishment of nutritive standards that will endure the test of scientific criticism, that will harmonize with daily experience, and that will prove to be physiologically correct.

Further, we need to know more concerning the relative decomposition within the body of the truly organized proteid matter of the tissues, and of the albuminous food-stuffs which, having been digested and absorbed, are in a sense a part of the tissues, but not thoroughly or completely incorporated as an integral part of the living cells. Does the urea of the daily excretion come primarily from the breaking down of the organized proteid, or does it come preferably from the disintegration of the circulating proteid? We recall the famous experiments of Schöndorff, in which blood was made to circulate through the muscles and liver of well-nourished and fasting dogs, with the result that the urea of the blood was increased only when the blood circulated through the tissues of a well-nourished animal. It made no difference with the result whether the blood employed was from a well-fed or a fasting animal; the essential factor was the condition of the muscle tissue through which the blood was made to flow. Schöndorff drew the natural conclusion that the extent of proteid metabolism was dependent upon the nutritive condition of the cells of the tissue, upon the mass of the living cell material, *i. e.*, upon the amount of morphotic proteid present, and that the proteid content of the intermediary fluids, as blood or lymph, was of no moment in determining the rate of urea formation.

We may well doubt, however, if all the urea formed daily under ordinary conditions of life comes solely from the breaking down of the truly organized or morphotic proteid. It is more than probable that the urea has at least a two-fold origin, and, if so, it is an important matter to be able to discriminate between that which comes from the breaking down of the unorganized albumin, and that which is derived from the organized tissues. Unquestionably, the decomposition of organized proteid, the morphotic part of the living protoplasm, is quite different from that of the unorganized pabulum of the cell and surrounding media. Quite possibly, the influences controlling the two lines of metabolism are different; perhaps, there are even different kinds of nerve control.

Equally important is it for the physiologist to know more fully regarding the sources of the carbonic acid resulting from oxidation in the body. What proportion of the ever varying output of this gaseous product of metabolism comes from the oxidation of organized tissue material, and what from the oxidation of circulating carbohydrate and fat and unorganized material in general? We have learned, for example, that the excretion of carbonic acid runs more or less closely parallel with the degree of muscular activity, and we should possess the means of discriminating between the output from true tissue oxidation and that which is derived from extra-cellular sources. A study of the excretion of carbonic acid by fasting individuals, under different conditions of life and activity, would be helpful in throwing light upon this question, and also in giving us a clearer idea of the minimal requirements of the body for non-nitrogenous foods to make good the loss of energy in heat liberation, muscular work, etc. By such a study we might hope for added light upon that much discussed problem, the source of the energy of muscular contraction. While most physiologists are certainly agreed that this energy comes preferably from the oxidation of non-nitrogenous matter, there remain many obscure points upon which we need enlightenment.

We likewise need fuller and more exact knowledge of the ways in which uric acid originates in the body, especially regarding its relationship to intracellular decomposition. Our present understanding of the two-fold origin of this substance—endogenous and exogenous—is most helpful in making clear many formerly obscure points connected with the formation of this substance from the different classes of foodstuffs. To-day, however, we understand quite clearly the genetic relationship between the free and combined purin bases and uric acid, but we are still uncertain whether this substance is formed to some extent synthetically and whether when once formed it is all eliminated unchanged or undergoes oxidation, in part, into less harmful substances. In other words, we do not yet know how far the uric acid which is contained in the daily urine is a measure of the *production* of uric acid for the twenty-four hours. Uric acid and the alloxuric bases are such important substances, in their influence upon health and the general nutritive condition of the body, that it is extremely important for us to know more concerning their origin and their ultimate fate in the body. We may likewise inquire where uric acid is formed. Does it originate entirely in the liver, or are there other depots where it is produced and collected?

Turning our attention now in another direction, we may revert to the relationship between stereochemical configuration and physiological action as a fruitful subject for investigation. Many interesting facts have already been gleaned, and certain general rules or laws have been

formulated, connecting given lines of physiological action with a definite chemical structure. Thus, it is well understood to-day, for example, that all substances which contain a nitro or nitroso group united with, or bound to, oxygen have the effect of dilating blood vessels, while, on the other hand, substances which contain the same nitro or nitroso group joined to carbon have a quite different physiological action, being mostly blood poisons. Further, nitrils, R. CN, tend to produce ccma, while isonitrils, R. N = C, are much more toxic and tend to produce paralysis of the respiratory center.* In other words, it is clearly manifest that certain definite groupings within the molecule are the cause of the physiological action of the molecule. At the same time, it is also known that in order to have the physiological action of a substance manifest not only must it contain the necessary group or groupings, but there must likewise be present a second group which has the power of combining with and holding fast to the tissue upon which the physiological action manifests itself. Slight chemical alteration of a substance may, therefore, interfere with or nullify its ordinary physiological action without necessarily altering the physiologically active groups; but by simply changing these other groups through which the molecule ordinarily attaches itself, so that the latter can no longer adhere to the cell substance or tissue protoplasm, there occurs a consequent loss of physiological action.

Another fact clearly understood is that two substances having the same nucleus and like side chains, with an entirely similar grouping, may still be physiologically unlike, owing to a different arrangement in space. This is well illustrated by the dextro- and lævo-rotary tartaric acids, one of which is readily utilized by *Penicillium glaucum* as nutriment, while the other can not be so consumed. Many other illustrations might be cited, especially with various types of organic poisons, all tending to show that physiological action is dependent upon the *arrangement* of the atoms or radicles in space, as well as upon the *nature* of the atoms or radicles. With these facts before us, we see many lines of inquiry presenting themselves, many problems demanding solution, with reference both to pharmacology and physiology.

Confining our attention more especially to physiological matters, we are certainly justified in considering the application of these principles to many of the substances conspicuous in the processes of the body. The work and suggestions of Pasteur and Emil Fischer have indicated certain possibilities regarding the nature and action of enzymes, not to be overlooked. Stereochemical configuration may be just as much responsible for enzyme action, for proteolysis, amylolysis, etc., as any other feature of the active molecule, and how far other lines of physio-

* See Fränkel, 'Ergebnisse der Physiologie,' *Dritter Jahrgang. Biochemie*, p. 291.

logical action may be due to chemical structure and the configuration of the molecule, who can say? One's thoughts naturally turn to the living muscle plasma and the chemical changes that follow or accompany the advent of rigor mortis; to the circulating blood and lymph, and the transformations that occur when these fluids are withdrawn from the protecting influence of the endothelial lining of the living vessels; to the axis cylinder of the nerve fibers and the changes that occur when the fibers are severed from their connection with the ganglionic cells. These, and many other suggestions arise, all calling for a further study of the chemical constitution and stereochemical configuration of the molecules involved, since in the knowledge thus gained may be found the solution of many physiological processes now shrouded in mystery.

The reference just made to nerve fibers and ganglionic cells suggests another problem in physiological chemistry, solution of which has been long deferred, viz., the exact chemical nature of nerve tissue, and the character of the changes involved in the passage of a stimulus or nervous impulse through a nerve to its ending in the muscle or secreting cell. Further, what is the real purpose of the complex myelin surrounding the axis cylinder of medullated nerves, and the corresponding substance imbedded in the gray matter of the brain and cord? These are problems that have long waited solution, and yet they are vital to any clear understanding of the nutritive or other changes that take place in nerve tissue, either in rest or in activity. Nerve tissue is strikingly peculiar in its large content of phosphorized bodies of the lecithin type, cérebrosides and cholesterins. These substances, complex in nature and of large molecular structure, are all alike in having the physical properties of fats. Further, lecithin and the cerebrosides all contain fatty acid radicles in large amount, and in addition lecithin contains the radicle of glycero-phosphoric acid. Moreover, the cerebrosides contain a carbohydrate group yielding galactose on decomposition, so it is plain to see that the bodies which give character to the myelin material are highly nutritive substances with high calorific power. These facts might readily be taken as indicating that the function of the myelin is to nourish the more important axis cylinder, to furnish the necessary pabulum for growth and repair, as well as to meet the daily demand for energy-yielding material.

While we may speculate, however, as to the part these peculiar substances play in the life of nerve tissue, we really possess very little positive knowledge of their true purpose. Indeed, we do not know how these bodies actually exist in the living tissue, as is well evidenced by the utter lack of agreement among physiological chemists as to the entity of the so-called protagon. Whether this phosphorized substance, studied by so many investigators, exists as such in the living tissue, or

whether it is simply an intimate mixture of lecithin, cerebrin and one or more other substances, is not yet settled to the satisfaction of all concerned. Further, it is not at all impossible that the cerebrosides, as well as lecithin and possibly cholesterin, may exist in the living tissue combined with some one or more of the proteids present there. Our lack of knowledge is deplorable, and yet, in the words of Sir Michael Foster, this is one of the 'master tissues' of the body. Surely, considering the preeminent position and controlling influence of this tissue, we may look for a speedy clearing away of the darkness that enshrouds our understanding of the exact chemical composition of nerve tissue, and especially of the way these peculiar substances of the myelin material exist in the living tissue.

Again, we may ask ourselves what is the nature of the chemical changes that take place in nerve tissue; in the ganglionic cells of the gray matter and in the axis cylinder of the nerve fibers? When a muscle contracts there is a measurable chemical decomposition. The energy of muscular contraction comes from the breaking down of non-nitrogenous components of the muscle, and perhaps in some measure from the decomposition of nitrogenous constituents. Further, there is a liberation of heat, a development of lactic acid, etc. When a stimulus is applied to a nerve, on the other hand, no such manifestations of chemical action are apparent. The muscle to which the nerve is attached contracts, the secreting cell pours forth the product of its activity, etc., but there is no noticeable change in the nerve itself, no recognizable liberation of heat, no change of reaction, no output of carbonic acid, that can be detected. Are we to conclude then that the axis cylinder of the nerve fiber acts simply as a conducting agent without itself undergoing any change? Is it to be compared to an electric wire, with the surrounding myelin material, the substance of Schwan, serving as a convenient insulating or protective medium? If we are to accept this view, what are we to say regarding the non-medullated fibers? Do not they need an insulating material likewise? We can argue that the myelin substance is especially adapted for the nourishment of the nerve, that its high potential value renders it peculiarly suitable as a concentrated nutriment, and that its intimate contact with the neuraxis and with the ganglionic cells of the gray matter proclaims its probable use in this direction. Moreover, if we follow this line of argument still further, we may be led to believe that the stimulation of a nerve, its power of conductivity, etc., are associated with chemical decompositions along its axis as marked in their way as those that occur in a contracting muscle fiber. Truly, we have here a multitude of questions, for which at present no satisfactory answers are to be found. The problems are on the surface awaiting solution.

Finally, emphasis must be laid upon a series of problems in physio-

logical chemistry, true solution of which will do much to explain natural and artificial immunity, the action of toxins and antitoxins, the bactericidal action of blood sera, the effect of oxidizing enzymes of animal and vegetable origin upon toxins of various kinds, etc. Ehrlich's theories regarding the protection furnished by antitoxic and bactericidal serums, so elaborately devised, constitute a working hypothesis of great value, but we need much additional knowledge concerning the nature and action of the so-called complements and anticomplements, of amboceptors, of haptophor groups, of agglutinins, of precipitins and of hemolysis. The physiological chemist studies with care the important and suggestive work being carried forward by the many brilliant investigators in pathology and bacteriology, with the feeling, however, that the true explanations for most of the phenomena in question are chemical, and that the actions and interactions involved are chemical ones, to be eventually made clear by a fuller chemical knowledge of the toxic and antitoxic substances themselves, and of their alteration and combination under different physiological conditions.

The well-known natural immunity possessed by some animals toward certain diseases, together with the difficulty experienced by most micro-organisms in developing in the healthy body; a difficulty which at once disappears when from any cause the tissues of the body lose their original vitality and vigor, all point to the presence in the healthy body of certain general or specific substances which are directly deleterious to the micro-organisms. Such substances are obviously bactericidal, and it is equally plain that in the bodies of many species of animals there are specific antisubstances present which are lacking in other species, thereby explaining the natural immunity of the former towards certain diseases. As is well known, blood serum possesses, as a rule, a bactericidal power upon most micro-organisms, and we have every reason to believe in the existence of specific substances in the serum which exert some influence upon the growth and development of micro-organisms, and also upon the toxic products they tend to elaborate. These protective substances—the alexins of Buchner—appear to be proteid in nature, resembling globulins, since they are precipitated from serum by the action of certain strong solutions of alkali salts, as sodium sulphate. We know, however, very little regarding their chemical nature aside from the fact that they are obviously very complex, although perhaps even this point is not quite certain. These protective substances are presumably elaborated by the leucocytes of the blood and lymph, cells rich in nuclein and nucleoproteid material. Doubtless, also, some of the gland cells in the body have a corresponding action; statements which, if true, tend to emphasize the possible proteid nature of the protective substances.

While in a general way we may say that the natural immunity to

certain bacteria possessed by some animals is due in large measure to an inhibition of the growth of the micro-organism, it must also be remembered that there is in many species a distinct immunity to the action of the poison which the specific micro-organism produces. This immunity depends either upon a destruction of the poison as by oxidation, upon a combination between the poison and some constituents of the active protoplasmic cells of the body, thereby rendering the poison inactive, or, lastly, to some action of the specific protoplasmic cells of the body usually affected by the poison, by which the latter is unable to combine with the cells upon which it ordinarily acts. All these suggestions, however, imply chemical reactions of some kind, and obviously should be understood for a betterment of our knowledge upon this important matter.

Again, the specific immunity which shows itself after exposure to a given disease, so that a second infection becomes practically impossible, can be explained satisfactorily only on chemical grounds, viz., by the presence in the blood and lymph of certain protective or immunizing substances which presumably originate through chemical changes in the blood-serum, under the influence of the bacteria causing the disease. These are chemical substances, formed through chemical decompositions or alterations of normal constituents of the blood, and obviously we need to know more of their exact nature.

Following Ehrlich's views, specific antitoxins, bactericidal sera, etc., result from the overproduction of molecules in cells which are sensitive to the action of toxins and other bacterial products. Antitoxins so formed unite with toxins, and the so-called complementary bodies and the bactericidal antibodies combine with the bacterial cells, thus affording protection. These processes of alteration and combination, however, are presumably all chemical, involving either alteration of chemical structure, or direct combination of bodies chemically the opposite of each other. Further, the so-called haptophor groups of the toxin molecule are probably represented in fact by chemical groups or radicles, which owe their power of combination with corresponding groups of other cells to chemical affinity. Again, the complementary body, normally present in all healthy blood sera and which is needed along with the specific antibody for the destruction of bacterial cells, must owe its activity to the power of chemical combination. Hence, we have presented to us at every turn the question of the chemical nature of these various substances, toxin and antitoxin, complement, receptor, haptophor, etc., which are of such vital importance in the production and maintenance of immunity and protection. Surely this is one of the most important problems of the present day in the domain of physiological chemistry, and calls for both patience and skill of the highest order in its solution.

THE AGRICULTURAL DISTRIBUTION OF IMMIGRANTS.

By ROBERT DeC. WARD,
CAMBRIDGE, MASS.

MANY of the evils resulting from the enormous immigration of aliens into this country during recent years have been much aggravated by the congestion of these aliens in the slums of our large northern cities. For this reason, most of those who have studied the immigration problem seriously have come to the conclusion that if these immigrants could be removed from the slums, and distributed over the agricultural districts of the west and south, all the difficulties which are now met with in educating and Americanizing these foreigners could easily be disposed of. The vastness of the problem of the city slum, and the impossibility, even with unlimited resources of men and money, of permanently raising the standards of living of many of our immigrants as long as they are crowded together, and as long as the stream of newer immigrants pours into these same slums, has naturally forced itself upon the minds of thinking persons. This note was struck in the last Annual Report of the Boston Associated Charities in the following words: "With an immigration as unrestrained as at present, we can have little hope of permanent gain in the struggle for uplifting the poor of our cities, since newcomers are always at hand, ignorant of American standards." And in a recent study of the Chicago Stock Yards strike, in which the miserable conditions are described under which the newer immigrants employed in the yards live, we learn that "from the poorest parts of Bohemia, Poland, Lithuania, and Slavonia, these immigrants have poured in great overlapping waves into the stock yards. The standard of living of each wave rises slowly, *constantly sucked down by the lower standards of the waves behind.*"*

The fact has become increasingly obvious during the past few years that in the 'Little Italys,' the 'Little Russias,' the 'Little Syrias,' in our city slums, we are finding more and more difficult and burdensome problems of public and private charity; of police; of education; of religious training; of public health.

Go down to Little Italy, says a writer of New York, and it is Italy. It has not only its market of Italian foods and other stuffs. It has its Italian feast days and processions and celebrations; and there are thousands of persons there who can hardly know that they have come from Italy. . . . It is a similar story, of course, that has many a time been told about the Ghetto. It differs

* The italics are the present writer's.

little from the Ghettoes of Europe, except for the touch of kindlier fortune. . . . A Syrian might go to sleep at home, and if he could sleep eight or nine days he might wake up in New York, and be perfectly at home in the Syrian quarter. . . . These quarters have long been here, and they are in all our cities. But the new thought is of their apparently indefinite extension.

The only remedies for such conditions are: a considerable restriction of immigration, *and* (not *or*) the distribution of the slum populations through the agricultural districts of the country. Although congress has repeatedly been asked, in the strongest terms, by very influential bodies of citizens all over the country, to enact further restrictive legislation, no laws at all adequate to meet the situation have been put upon the statute books. The powerful influences of railroad and steamship companies, and of large employers who want 'cheap' labor, have been able to turn the scale against what the majority of Americans without question believe to be the best for the country. The first of the two remedies above referred to not having been secured, there has been a decided swing of opinion in favor of the second. Any one who reads over recent literature on immigration will find constant reference to the 'solution of the immigration problem by the agricultural distribution of our immigrants.' That charity workers should have been so long finding out this (supposedly) excellent and effective remedy, which is lauded as if it alone were to be the panacea for all the ills resulting from immigration, is much more surprising than that the steamship and railroad interests of this country should be doing their utmost to 'boom' it as *the one* solution of the immigration problem, always carefully concealing their own interest in the matter, which is to increase their receipts through the transportation of all these thousands of immigrants, to secure cheaper labor, *and to turn public attention away from the need of further restrictive legislation.* The advocacy of the distribution plan by those having affiliations with transportation interests, or with enterprises which desire 'cheap' labor, especially in the less thickly settled parts of our country, will bear careful watching.

The relief which a distribution of the inhabitants of our city slums seems sure to bring to the charity workers and the philanthropists of our large northern cities, and the fact that such distribution is also being systematically, though not openly, advocated by powerful transportation and capitalistic interests, have caused this new idea to be welcomed with great enthusiasm, the selfish and unselfish interests working along the same lines, as is seldom the case in immigration matters. In all this enthusiasm for the new remedy it is natural that there is danger of going too fast and too far; there is a likelihood that we are urging distribution from our congested districts without caring sufficiently where the people whom we are anxious to get off our hands

go to; whether the removal will accomplish as much as is expected of it; whether the people among whom these foreigners are scattered really want them; whether removal on a wholesale scale will not develop new agricultural colonies of aliens in which some of the evils of the slums will be reproduced anew; whether the effects of such dispersion on the communities among which the new settlers are located will be for the best of those communities in the long run; whether—and this is perhaps the most important point of all—wholesale distribution will really relieve the city's burden. It is because the writer realizes that distribution is a remedy for existing evils which may well be added to the more fundamental one of a further restriction of immigration, and because he realizes that many persons have advocated the distribution idea without giving it careful thought, that the writer desires to call attention to a few points which need discussion before we go any farther in the matter.

1. *Expense.*—To scatter the city slum populations on any scale large enough to be at all effective would require vast sums of money, if the thing is done intelligently. It is not enough simply to pay the fares of hundreds of thousands of persons from the cities to distant points in the west or south, but provision should be made for the new arrivals when they reach their destination, and they usually need care and oversight for a good many years. It is obvious that if immigrants who have just landed can be persuaded, or forced, to go at once into the country districts at their own expense, or at the expense of some railroad or capitalist desiring 'cheap' labor, philanthropic persons would be saved the immediate cost of the transportation. It must be remembered, however, that wholesale distribution by railroads or capitalists is not likely to be controlled by a desire to do what is best for the immigrants, nor for the people among whom they are scattered, but rather by purely selfish interests. Furthermore, the natural tendency of most of our immigrants is to remain in the larger cities, because of their desire to be with large numbers of their fellow-countrymen, because the majority of the newcomers have very little money and because the cities are the centers for manufacturing and mechanical industries, which are on the whole more remunerative than agriculture. The average amount of money brought by each immigrant during the last five years was sixteen dollars. In the Report of the Industrial Commission it is shown that the amount of money brought by immigrants from northern and western Europe averages considerably greater than that brought by those from southern and eastern Europe, but it is the latter class which it is chiefly desired to distribute. To be really effective, thousands of families should be removed from the slums of New York, and Chicago, and Boston, and other cities, every year, and the incoming of two or three times as many

families of newer immigrants of the same standards of living should be checked.

2. *Success thus far attained not altogether Encouraging.*—The attempts which have already been made along the line of the distribution of recent immigrants from our city slums, admirable as they are, and much as they deserve support, have on the whole been sadly ineffective. The Jewish Industrial Removal Society of New York, with the aid of the Hirsch fund, has distributed many Jewish families in the country, partly in agriculture, but usually in trade. Last year this society sent more than 3,000 persons to 45 states, three per cent. being on record as having already drifted back into cities. Similar societies are at work in Chicago, Philadelphia and Boston, and the Italian societies are doing the same sort of work. Although in most cases the individuals thus removed have fared better in their new homes than in the slums, yet taken as a whole, the success thus far attained is not so encouraging as to lead thoughtful persons to be sanguine about the entire practicability of carrying out a successful scheme of wholesale distribution along similar lines. And while there have been successes in the past, there have also been many dismal failures, and in almost all such attempts very great difficulties have been met.

3. *Most of our Newer Immigrants not adapted to an Agricultural Life.*—It is a mistake to suppose that all immigrants can be turned into successful farmers simply by sending them into the country. The commissioner of immigration at the Port of New York says in his last annual report (1903): 'Thousands of foreigners keep pouring into our cities, declining to go where they might be wanted because they are neither physically nor mentally fitted to go to these undeveloped parts of our country, and do as did the early settlers from northern Europe,' and this is especially true of most of the immigrants who, because of the steamship rate war, have been coming over to this country during the summer of 1904 for less than $10 a head. Such a rate makes it possible for the most ignorant and the most depraved inhabitants of Europe's slums to come here. Would a railroad fare of say $5 from Chicago to southern California induce the best or the least desirable of Chicago's residents to take advantage of the opportunity to go west? Long residence of successive generations in the Ghettoes of Europe has unfitted most of the Jews to be independent farmers; the Syrians and Armenians take naturally to non-agricultural occupations, and so it is with others. The majority of our recent immigrants from southern and eastern Europe are too poor and too ignorant to be fitted for a successful farming life. In this connection Mr. Gustavo Tosti, Acting Consul-General of Italy in New York, who has given much time to the study of the conditions of Italians in this country, says:

> There is a misleading idea in certain quarters that 'the agricultural distribution of Italian immigrants' should be obtained simply through the employment of a large number of Italians as farm workers and farm hands. This would be only a palliative measure. The character of agricultural work is, by its very nature, precarious. The Italian immigrants would thus find employment during a few months of the year, when, for instance, at harvest time, there is an enormous demand for labor. . . . But after a comparatively short period of occupation they would lapse into enforced idleness, which would undoubtedly drive them back to the industrial centers. The only way to get at the root of the question is to transform a large portion of our immigrants into landowners or farmers.

To transform ignorant laborers, with but a few dollars in their possession, into landowners, is not a matter of a day or a year. It involves an expenditure of time and money. It is a matter of the assimilation of the immigrant and of the elevation of his standards of living. Thus, neither the interests of those states which desire immigrants who shall at once buy their land, nor the best interests of the Italian immigrants themselves, as set forth by Mr. Tosti, are met in a wholesale distribution of ignorant farm laborers. The difficulty of having large numbers of farm laborers in idleness for much of the time, to which Mr. Tosti also refers, is already present, as may be seen in the following statement, clipped from a newspaper of last summer:

> Several of the largest planters in the delta have made contracts with the labor agencies in New York to secure for them gangs of Italian immigrants, who are now being brought south by the coach load. . . . The Italian laborers who are now being imported will not have very much to do until the cotton-picking season opens, and the immigrants will be maintained by the planters in comparative idleness until picking begins.

4. *Do the Country Districts want the Kind of Immigrants whom it is proposed to send to them?*—No distribution of our immigrants should be thought of if the states to which they are to be sent do not welcome them. A few years ago, the U. S. Immigration Investigating Commission asked the governors of the different states what nationalities of immigrants they desired, and in only two cases was any desire expressed for Slavs, Latins, Jews or Asiatics, and both of these two cases related to Italian farmers, with money, intending to become permanent settlers. A canvass of the same kind, made within six months by some gentlemen who are interested in the distribution scheme, showed that these preferences have undergone no appreciable change. In every case, in this recent canvass, the officials protested against the shipment of southern and eastern Europeans from the city slums into their states. In the south to-day, owing to the lessened efficiency of the negro, the greater demand for field laborers, and the movement from the country into the towns, the need of pickers in the cotton fields is very great in some sections, and the demand for vast hordes

of any kind of laborers—even the most ignorant of newly-arrived aliens —is referred to in the newspapers. But this demand for the cheapest labor without regard to the effects which the importation of such laborers will have upon the community, apparently comes from a comparatively limited number of capitalists, and from the southern railroads. The majority of the thinking people of the south, if they know something about the evils which have come in the train of the newer alien immigration in the north, will not look with favor upon the wholesale importation of cheap and ignorant alien labor. Several of the southern states have emphatically stated what nationalities of immigrants they want, and their preferences are for people from the northern United States and for northern Europeans. Thus, South Carolina, concerning which a leading authority on the south has said that there is no state in the Union in which 'there is a more general desire for more white men who are willing to work with their hands,' has, through its legislature, recently voted that its new commissioner of agriculture, commerce and immigration must confine his activities in securing new immigrants to 'white citizens of the United States, citizens of Ireland, Scotland, Switzerland, France and all other foreigners of Saxon origin.' The general demand in the south and west is for the intelligent 'settler who has means of purchase,' not for the newly-arrived, ignorant and penniless immigrant, who 'would require the fostering care of government or of wealthy private societies.' The land companies and large private owners of land are in search of purchasers who have resided in the United States for some years and are familiar with American customs, or else of immigrants with some money, coming from northern Europe. To send out to other states thousands of aliens who are not really desired there, simply because we think we can thus relieve ourselves of an unpleasant burden, is much like throwing our weeds over our neighbor's fence, into our neighbor's garden.

There doubtless is need of labor in the south to-day; the Italian is unquestionably well fitted to do much of the work which needs doing; and in those parts of the southern country where Italians have settled, they have proved their ability and willingness to do work at least equal to that of the negro in the cotton-fields; they are praised as industrious, thrifty, good citizens, frugal, and as having increased land values. On some railroads, also, they are reported as being satisfactory laborers. On the other hand, it must be noted that the most successful settlements have been those of *northern* Italians; that the greater desirability of the northern Italian is generally recognized wherever experience has been had with both northern and southern Italians, and that thus far the number of Italians in the south has been small and practically none of the less happy consequences of the congestion of separate nationalities have been noted. The favorable reports which have

recently been made by Chevaliers Rossi and Rossati as to the conditions and prospects of Italian immigrants in the Mississippi delta; the plans which are being formed for the transportation of tens of thousands of Italians to the southern states, either by the new direct steamship line from Italy to New Orleans or by the train-load from the slums of New York and of other northern cities or direct from Ellis Island—it all sounds like an attractive program for the Italians. But does the scheme sound altogether as attractive to those southerners who have the best interests of their own country at heart, and who fully appreciate how grave are the social and political responsibilities which already weigh upon their fair land? The south should think twice before it allows its capitalists and its railroads to flood the country with 'cheap' and ignorant alien laborers. A leading newspaper of the south has recently said that the southern states want no such immigrants as have crowded the east side of New York and the factories of New England. Unless steps are taken by the south to prevent it, much the same conditions may be developed there within a few years.

5. *Wholesale Distribution soon involves Foreign 'Colonies.'*—One of the objects of the agricultural distribution of our recent immigrants is to prevent the congestion of the different nationalities in colonies, by scattering these people, as it is said, 'among the native population.' Now while distribution in country districts does, of course, in all cases, prevent such congestion as is characteristic of city slums, the tendency for recent immigrants from southern and eastern Europe to herd together in settlements of their own is almost as marked in the country as in the cities. Moreover, this unfortunate tendency—unfortunate because it retards assimilation—is in many cases fostered by philanthropic societies and by railroad and land companies. The following headings, clipped at random from newspapers of recent dates, show how distinctly the much-talked-of 'agricultural distribution' of our newer immigration tends towards the formation of alien colonies. "Poles going to Michigan. The Milwaukee branch of the Polish National Alliance of America has purchased 50,000 acres. It is planned to establish other large colonies." "The latest phase of the New Zion problem is to purchase a large tract of land in Wisconsin for the immigrant Jews from Roumania and from Russia." "Jewish colony for Michigan. Russian and Polish refugees to settle on the line of the Escanaba and Lake Superior R. R. They are brought by a committee in New York." "Hungarians coming to Texas. About 500 families from southern Austria to settle on line of Southern Pacific." "Hungarian colony planned. A $200,000 company to establish town sites in Jackson Co., Arkansas. E. E. Barclay, Immigration Agent of the St. Louis, Iron Mountain and Southern R. R., is the chief stockholder." (The last sentence is significant of the moving

spirit behind many of these new colonies.) "Russian Jew colony in Alabama. The colony will consist of 40 Russian Jew families, and they propose to establish a manufacturing settlement, principally for the making of *clothes.*" And so on, *ad libitum.* It is obvious that the establishment of such alien colonies is not conducive to thorough and rapid assimilation, and that, if this is the tendency of 'agricultural distribution,' the benefits to be derived from such distribution are certain to be much lessened.

The present view regarding our alien immigration is not that of criticism of, nor of prejudice against, any one nationality or group of foreigners. Hence the frequent outbreaks of impassioned defense of this or that nationality are both unnecessary and misleading. The sober thought regarding the dangers of immigration is that of apprehension that an ever-increasing mass of our alien population which keeps its identity is a great evil in our democracy. These alien colonies have for years been found in our city slums; the present movement is evidently going to plant them all over the country, in the farming districts. The thought of danger in alien colonies is, after all, not as new as many writers would have us believe. Washington, in a letter to John Adams, dated November 27, 1794, wrote as follows: "My opinion with respect to emigration [immigration] is that except of useful mechanics and some particular descriptions of men and professions, there is no need of encouragement, while the policy or advantage of its taking place in a body (I mean the settling of them in a body) may be much questioned; for by so doing they retain their language, habits, and principles, good or bad, which they bring with them." And Franklin expressed it as his belief that a homogeneous population is necessary to a successful democracy.

6. *Effects upon the Sections in which the Distribution takes Place not always good.*—To scatter among our rural communities large numbers of aliens whose standards of living are such that they are willing to work for the lowest possible wage, is to expose our native farming population to a competition which is distinctly undesirable. In the corn belt of the west, as Professor T. N. Carver has recently shown, the newer immigrants, because of their lower standards of living, have been able to put more money into land, buildings and equipment than the native American farmer; and hence have an advantage in the struggle for existence. Scattering our alien population of the more ignorant races simply spreads more widely the evils which result from exposing our own people to competition with the lower classes of foreigners. Again, in the case of the agricultural distribution of Italian and other alien laborers through the south, while it is perfectly true that these aliens will supplant the negroes in many—probably in most—occupations, the effect will undoubtedly be to cause a

migration of the negroes to the cities—a result which those familiar with the conditions of negroes now congested in cities can not fail to view with the greatest alarm. Lastly, the more widely we scatter the newer immigrants, the more widespread will be the effect of the competition with the lower grades of aliens in causing a decrease in the birth rate among the older portion of our population. American fathers and mothers, as the late Gen. Francis A. Walker first pointed out, and as leading authorities have since reiterated, naturally shrink from exposing their sons and daughters to competition with those who are contented with lower wages and lower standards of living; *and therefore these sons and daughters are never born.* The agricultural distribution of immigrants from southern and eastern Europe, and from Asia, will hasten still more the replacement of the native by foreign stock.

7. *Agricultural Distribution of Immigrants will not solve the Immigration Problem.*—But few of those who are now urging the necessity of relieving the city slum burden by distributing the slum population realize that such distribution will not, and can not, of itself, lead to any relief, as long as the tide of new immigration flows on unchecked. As Professor John R. Commons, one of the leading authorities on immigration in the United States, has recently said:*

> **To relieve the pressure in the cities without restricting the number admitted only opens the way for a still larger immigration; for, strangely enough, emigration has not relieved the pressure of population in Europe. In no period of their history, with the exception of Ireland, have the populations of Europe increased at a greater rate than during the last half century of migration to America. As a relief for current immigration, agricultural distribution is not promising.**

It needs but little thought to convince any one that were it not for the continued influx of hundreds of thousands of ignorant and poverty-stricken aliens each year, there would, in few years, remain no such serious problem of Jewish charity, or of Italian charity, or of any other charity in our country as at present. It is a fact, so obvious as to need no argument in support of it, that the more we try to reduce the pressure of competition among the alien immigrants in our congested city slums, the more we shall encourage other aliens, as ignorant and as poor, to come over and take the places thus vacated. Distribution and a reduction in the numbers of our immigrants: both of these remedies are needed. Private charitable agencies are not likely to have money enough to carry out any scheme of distribution on a large scale; that will be attended to by the capitalistic interests which want the cheapest labor obtainable. Charitable societies and individuals should do their best to see that this distri-

* *The Chautauquan*, May, 1904, 224.

bution is intelligently directed, and that the alien colonies which are being formed in our farming districts do not become a menace. As to a reduction in the numbers of our alien arrivals, that is a work in which all who have at heart the best interests of their country, of the immigrants who are now here, and of those who are still to come, should join hands to accomplish. As Mr. Robert Hunter has recently said:* "If we let the steamship companies and the railroads, wanting cheap labor, alone, we shall not decide what immigrants will be better for coming, and what ones the country most needs. They will decide it for us." There are two feasible remedies for reducing immigration now before congress. One, the illiteracy test, which has the support of the great majority of those who have studied the immigration problem carefully, and which has been strongly endorsed by President Roosevelt, the commissioner-general of immigration, and the boards of organized charity throughout the country. The other suggested by Congressman Robert Adams, Jr., of Pennsylvania, which would restrict to 80,000 the number of new immigrants who could come to us from any one foreign country in any one year. In his last Annual Report the Commissioner of Immigration at New York said:

> I believe that at least 200,000 (and probably more) aliens came here (last year), who, although they may be able to earn a living, yet are not wanted, will be of no benefit to the country, and will, on the contrary, be a detriment, because their presence will tend to lower our standards; and if these 200,000 persons could have been induced to stay at home, nobody, not even those clamoring for more labor, would have missed them. Their coming has been of benefit chiefly, if not only, to the transportation companies which brought them here.

To exclude this surplus of undesirable aliens, and to distribute the others over our farming districts where they can find suitable work and where they are wanted, is one of the most important problems before the people of this country.

---

* *The Commons*, April, 1904, 117.

THE CONCEPTIONS AND METHODS OF PSYCHOLOGY.

By Professor J. McKEEN CATTELL,
COLUMBIA UNIVERSITY.

ONE of the verses in the treasure-house of Greek letters warns us against calling any man happy before he is dead. The greatest living English author lets one of his favorite characters say: 'But does incessant battling keep the intellect clear?' Such reflections may well lead us to distrust any attempt, by one in the ranks, to sum up the fundamental conceptions and methods of a science, especially of a young and growing science. It may be the prerogative of the student of psychology to write the biography of an infant, but he has not hitherto penetrated very far into its real life. I disagree completely with the eminent psychologist to whom the plan of this great congress is chiefly due when he claims that 'the presuppositions with which a science starts decide for all time the possibilities of its outer extension.' Sciences are not immutable species, but developing organisms. Their fundamental conceptions and methods at any period can only be approached by a research into work actually accomplished. Had time and circumstance permitted, I should have attempted to make an inductive study of the contents and methods of psychology rather than to prepare three quarters of an hour of generalities and platitudes. But as even the pedant knows, 'die Kunst ist lang, und kurz ist unser Leben.' The court poet must console himself for the deficiencies of his ceremonial verses by reflecting on the honor of being permitted to write them.

The concept of a science is an abstraction from an abstraction. The concrete fact is the individual experience of each of us. Certain parts of this experience are forcibly and artificially separated from the rest and become my science of psychology, your science of psychology, his science of psychology. From all these individual sciences, shifting not only from person to person but also from day to day, there arises by a kind of natural selection a *quasi* objective science of psychology. In a well-bred science, such as chemistry, the conventions have become standardized; the dogmas impose themselves on the neophyte. But projectiles as small as ions or electrons break up the idols, and the map

* An address at the International Congress of Arts and Science, St. Louis, September, 1904.

of science is remodeled more quickly and completely than the map of Asia.

Psychology has never had a well-defined territory. As states of consciousness appear to be less stable and definite than the objects of the material world, so the science of psychology is more shifting in its contents and more uncertain in its methods than any physical science. We are told indeed in our introductory text-books that psychology is the science of mind and that mind and matter are the most diverse things in the world. It is said further that psychology is a positive science and is thus clearly distinguished from the normative disciplines, such as logic and ethics. Words are also used to set psychology off from sociology, history, philology and the rest. But while all these verbal definitions may satisfy the college sophomore, they must be perplexing to the candidate for the doctor's degree.

The distinction between mind and matter is one of the last words of a philosophy which does not yet exist, rather than an axiom of every-day experience on which preliminary definitions may be based. We can not rest satisfied with an empirical psychology in which the distinction is self-evident, an epistemology in which it is explained and a metaphysics in which it disappears. It may be that we follow Descartes rather than Aristotle in our psychology, not so much from the needs of the science itself as from the demands of the church, on the one hand, and of physical science, on the other. The church required souls that might be saved or damned; physics wanted a world independent of individual perception, and as the methods of exact science were extended to the human body it became a part of the physical system.

To us who have been brought up in the orthodox tradition, the views of some of those who have passed from natural science to metaphysics seem decidedly naive. Thus Mach entitles the concluding section of his *Science of Mechanics* 'The Relations of Mechanics to Physiology,' when he is discussing not the question as to whether vital phenomena may be reduced to the laws of matter in motion, but the relations between sensations and the physical stimulus. Pearson tells us in his *Grammar of Science* that if the cortex of one brain were connected with another by a commissure of nerve substance, there would be 'physical verification of other consciousness.' Ostwald lets energy do hermaphroditic service in the physical and the extra-physical households.

But it is not certain that such ingenuous commingling of the mental and the physical worlds is more repugnant to common sense or natural science than the logical subtleties of the schools, which undertake to define, relate or obliterate them. It is generally assumed that a psychologist must be either an interactionist or a parallelist. Ac-

cording to the definitions with which our psychologies start, it is indeed true that mind and matter must either interact or in some way correspond without interaction. If the psychologist asserts that each brain is a center for the creation of new energy or for interference with the configuration of a material system, he obviously subverts the principal generalizations of physical science. He doubtless has a right to do so, but in the same sense as the cow has a right to stop the locomotive engine. If, on the other hand, the psychologist modestly admits that mind does not affect the physical order, he runs counter to the principal generalization of biological science. If pleasure and pain, memory and forethought, are of no use in the struggle for organic survival, why should they ever have evolved?

It requires less temerity to question the theories of biology than to deny the laws of physics. The survival of the fit may be regarded as a truism rather than as a discovery, if we call that fit which does survive. But fitness of this kind is so protean in its manifestations in organic nature that the formula becomes somewhat vague. If an animal is inconspicuously colored, it is protective coloration and so useful; if conspicuously colored, it is directive coloration and so useful. It is somewhat difficult to guess the utility of the fantastic shape and color of each deep-sea fish that lives in perpetual darkness. Then there are admittedly correlated variations, by-products of evolution, diseases and the like; it may be that consciousness is that sort of thing. If some kinds of consciousness, as the sense of beauty, are of no use in the struggle for existence, all the rest may be equally useless—an efflorescence exhibited when there is friction due to lack of adjustment between the organism and its environment. Finally, and most plausibly, it may be argued that minds have evolved in answer to final causes, and that organic evolution must adopt the principles of psychology rather than prescribe to it.

The interactionist seems to be in a worse plight than the parallelist in the conflicts with our sister sciences, but the case is different before the court of common sense. The present writer can not conceive how the parallelist gets outside the limits of consciousness. Why does he want any thing to run parallel with the only thing he knows? He becomes at once a subjective idealist, and there may be no harm in that. But when the subjective idealist wants to live in a world with other men, he reinvents the distinctions that he had verbally obliterated. What he knows about the physical world is what his senses and the physicists tell him; if he likes to call it all consciousness or the unconscious, mind-stuff, will or God's thought, this may be emotionally stimulating, but no fact or law is thereby altered. The world may be God's thought, without in the least preventing the parallelist from thinking illogically.

If clarified experience is subverted by logic, we can of course become sceptics; but it is safer and wiser to wait awhile. Experience may become more clarified, our premises may prove to be at fault, even our syllogisms may be false. When it is said that a psychologist must be either an interactionist or a parallelist, and we find insurmountable difficulties in the way of his being either, the trouble may be with the original assumptions. Matter and consciousness may not be two entities set over against each other. A perception may be both a part of my consciousness and a part of the physical world; an object may be at the same time in a world of matter in motion and in the microcosm of my individual mind. As my colleague, Professor Dewey, starting from an idealistic standpoint, claims, we may simply be giving different names to activity when it is tensional and when it is relatively stable; or as my colleague, Professor Woodbridge, starting from a realistic standpoint, suggests, the relation of consciousness to objects may be analogous to that of space to objects.

As I have said, the relations of mind to body and the distinction between consciousness and matter are the last word of a philosophy that is not yet written, and I have no competence or wish to discuss them here. But the task has been assigned to me of considering the scope, conceptions and methods of psychology, and it is my business to define the field of psychology or to acknowledge my inability to do so. I must choose the latter alternative. I can only say that psychology is what the psychologist is interested in *qua* psychologist. If it is said that this is tautological, it may be replied that tautology is characteristic of definitions. If psychology is defined as the 'science of mind' or, what in my opinion is better, 'the science of minds' the tautology is equal, and it appears to be more possible to determine by an inductive study the professional interests of psychologists than to define the nature of mind or consciousness. Further, I am not convinced that psychology should be limited to the study of consciousness as such, in so far as this can be set off from the physical world. Psychology apart from consciousness is doubtless an absurdity, but so also is mathematics or botany. I admire the products of the Herbartian school and the ever-increasing acuteness of introspective analysis from Locke to Ward. All this forms an important chapter in modern psychology; but the positive scientific results are small in quantity when compared with the objective experimental work accomplished in the past fifty years. There is no conflict between introspective analysis and objective experiment—on the contrary, they should and do continually cooperate. But the rather widespread notion that there is no psychology apart from introspection is refuted by the brute argument of accomplished fact.

It seems to me that most of the research work that has been done by me or in my laboratory is nearly as independent of introspection as work in physics or in zoology. The time of mental processes, the accuracy of perception and movement, the range of consciousness, fatigue and practise, the motor accompaniments of thought, memory, the association of ideas, the perception of space, color-vision, preferences, judgments, individual differences, the behavior of animals and of children, these and other topics I have investigated without requiring the slightest introspection on the part of the subject or undertaking such on my own part during the course of the experiments. It is usually no more necessary for the subject to be a psychologist than it is for the vivisected frog to be a physiologist.

James and Wundt agree in telling us that the experimental method is chiefly of use as a servant of introspection; indeed James says that there is no 'new psychology,' 'nothing but the old psychology which began in Locke's time, plus a little physiology of the brain and senses and theory of evolution, and a few refinements of introspective detail.' But our leaders in psychology have become our leaders by belying such partial statements. Although neither Wundt nor James has attempted any considerable experimental research, yet we look up to them as the founders of modern psychology. Wundt's original and laborious *Physiologische Psychologie,* the Leipzig laboratory and the *Philosophische Studien* have been in large measure the foundation stones of experimental psychology. The broad opportunistic treatment of James, instinct with genius and fearless of logical inconsistency, has been of immense service in freeing psychology from traditional fetters. I see no reason why psychology, at least the psychology of twenty years ago, may not be said to be the subjects treated in James's *Principles of Psychology* and Wundt's *Physiologische Psychologie* with such additional subjects as other psychologists have included or might have included in their treatises.

When the introspective purist says that the treatises of Wundt and James are potpouris of sciences, or that the kind of work that some of us have attempted to do belongs to physiology or to anthropometry or nowhere in particular, there is a natural temptation to reply that much of introspective and analytic psychology belongs to art rather than to science. Such things may be ingenious and interesting, like the personae of Bernard Shaw or the mermaids of Burne Jones, but we don't expect to meet them in the street. An attitude of this kind would, however, be as partial as that which it seeks to controvert. Let us take a broad outlook and be liberal in our appreciation; let us welcome variations and sports; if birth is given to monstrosities on occasion, we may be sure that they will not survive.

Any attempt at *a priori* limitation of the field of a science is futile.

Even if, for example, consciousness and matter in motion were distinct and distinguishable, this would be no argument against a science of physiological psychology. Cerebral and psychical phenomena form one series, and if we have at present no adequate science which concerns itself with this series, it is owing to ignorance of facts, not at all to logical limitations. Matter, time, space and the differential calculus may be as disparate as possible, but are brought together in the science of physics. If the psychologist can not be shut out of the physical world, still less can he be excluded from the sphere of the so-called normative sciences. If any one takes a modern work on ethics or esthetics and tries to separate the treatment of 'what is' from that of 'what ought to be,' he will find himself engaged in an idle task.

It appears that the limits of a science are set largely by a psychological constant. A single science has practically the range that can be covered by a single mind or man. From Aristotle to Hobbes and Descartes there were philosophers who could master nearly the whole range of knowledge and advance it in whatever direction they cared to turn. But even in this period as knowledge accumulated, specialization began, and we find astronomers, anatomists and other students of particular sciences. After Galileo and Newton the physico-mathematical sciences became completely divorced from the descriptive natural sciences, while psychology remained under the shelter of philosophy. It was only in the second half of the nineteenth century that the accumulation of certain facts and theories warranted their becoming the chief interest of a psychologist, and even yet it is more usual for a man to pass through a psychological period than to be a permanent psychologist.

While the first result of increased knowledge has been the establishment of a number of sciences—say a dozen or a score—which have secured proselytes and to a certain extent limited and directed their activities, the further increase of knowledge must break down the artificial limitations. The late emergence of psychology has made easy an elective selection of material. We not only have psychologists who are also philosophers, but psychologists who are also physiologists, anatomists, pathologists, zoologists, anthropologists, philologists, sociologists, physicists or mathematicians. Psychology is and will increasingly become united with professions and arts, with education, medicine, music, painting and the rest. Even sciences remote from psychology, astronomy, for example, may have sufficient points of contact to occupy the entire time of a specialist. We not only have combinations between the orthodox sciences, but cross-sections through them, which may to advantage occupy the student, and which have full rights to be ranked as sciences. The phenomena of vision, for example, are scattered among the sciences of psychology, physics, physiology, anatomy, anthro-

pology, zoology, embryology, pathology, chemistry, mathematics, etc.; they are important factors in certain fine and industrial arts; they are the basis of one of the most important medical disciplines. Why should not a man be a 'visionologist' or 'sightonomer'? When President Hall gives us an original and unique book on adolescence, nothing is gained by attempting to assign it to one of the conventional sciences. The work of Dr. Galton appears to me to be particularly unified, but it does not belong to psychology, nor to any other science. Why not call him an opportunist, or a liberal unionist, or a Galtonist, or better still call him no name at all?

In objecting to an artificial limitation of the field of the psychologist, I by no means want to aggrandize his office or to let psychology eat up the other sciences. The student of psychology is limited by the capacity of the human mind and of his own particular mind; he can, on the average, cover a range about as large as that of the student of any other science. If he would gladly get, he would also gladly give. If he is an imperialist who would set his flag on every corner of the earth, he yet tears down no other flag and welcomes the invasion of his own territory by every science.

As I claim for psychology the freedom of the universe in its subject-matter, so I believe that every method of science can be used by the psychologist. The two great achievements of science have been the elaboration of the quantitative method on the one hand and of the genetic method on the other. The uniformity of nature and the rationality of things are here presented in their most convincing, or at all events most plausible form. It would be an irreparable limitation if either of these methods did not apply in psychology. In my opinion they not only do obtain but must obtain. The mental and the physical are so inextricably interfused that quantitative and genetic uniformities could not exist in the physical world if absent from consciousness. If our mental processes did not vary in number, if they did not have time, intensity and space relations, we should never have come to apply these categories in physics, chemistry or astronomy. I am not prepared to attempt to clear up the logical questions involved; when water is muddy it is often wise to wait for it to settle rather than to keep stirring it up.

Under the conditions of modern science nearly all observations are experiments and nearly all experiments are measurements. A sharp distinction is usually drawn between an experiment and an observation. Thus Wundt, following Mill and other logicians, defines an experiment as an observation connected with an intentional interference on the part of the observer in the rise and course of the phenomena observed. But it is as properly an experiment to alter the conditions of observation as to alter the course of the phenomena observed. If the astronomer

goes to the ends of the earth and photographs a solar eclipse, making all sorts of measurements and calculations, we may say that this is an observation and not an experiment, but we have not made a useful definition; neither do we gain anything by deciding whether it is an experiment when a baby pulls apart a doll to see what is inside. The real distinction is between the casual experimenting and observing of daily life, and the planned and purposive experiment and observation of science. Science is experimental *qua* science.

I consequently object to making experimental psychology a branch of psychology. It is a method in psychology, which is extended just as rapidly as psychology becomes a science. The purely introspective or analytic observer does, according to the current definition, continually make experiments, because his introspection itself alters the process that he is observing, thus sometimes making his observations invalid as a description of natural conditions. On the other hand, the student in the laboratory may measure the process without any introspection or interference with it, and this may not be technically an experiment at all, but it gives a scientific description of the normal course of mental life. We are told that Adam gave a very appropriate name to the hog; science is not always so fortunate in its nomenclature.

Most experiments, letting experiments mean attempts to increase scientific knowledge, are also measurements. Measurement is only a description; but it has proved itself to be the most economical, wide-reaching and useful form of description. What language was for the evolution of primitive man, measurement is for the advance of modern science. As a word selects similarities and ignores differences, so a measurement selects certain similarities from the concrete manifoldness of things. That such a great part of the world can be described in terms of a few units of measurement, and that this description should lead to such useful applications, is truly marvelous and admirable. As I am writing these paragraphs, I have received a manuscript in which the author explains that the fact that the earth rotates on its axis in twenty-four hours, not varying a second from day to day, is a conclusive proof that it was created and set rotating by a benevolent being. If the days were shorter, he says, we could not get our work done, and if the days were longer, we should be too tired by night. It almost seems as though the world were made in such comparatively rational fashion in order that we may measure it.

The physicist counts, and he measures time, space and energy. He has intractable matter with its seven and seventy elements, and he may come across a substance as complex and perplexing as radium. But by and large he can describe his world in certain quantitative formulas. It is true that he accomplishes this in part by unloading on psychology qualitative differences, such as colors and tones. So much the

more satisfaction to us if we can reduce them to quantitative order. Perhaps we shall have only partial success; but it may fairly be urged that psychology has done as much in this direction in fifty years as physics accomplished to the time of Galileo or chemistry to the time of Lavoisier.

The psychologist counts and he measures time, space and intensity. Even if it were true—I think it is not true—that mental magnitudes are not measurable, it would none the less be the case that mental processes are described in quantitative terms. This is attempted and accomplished in most of the researches published in our psychological journals. They describe measurements and the correlation of quantities; they show that a mental mechanics is more than a possibility.

The physical sciences have been primarily quantitative and the biological sciences are primarily genetic, but the physical sciences must become genetic and the biological sciences must become quantitative. Psychology is from the start both quantitative and genetic. It may indeed be claimed that it is the science in which the genetic method has the most complete application. Every mental state and every form of activity is the result of development from previous conditions. If explanation, as distinguished from description, is possible anywhere in science it is possible here. It is certainly difficult to penetrate by analogy into the consciousness of the lower animals, of savages and of children, but the study of their behavior has already yielded much and promises much more. Although those who make their psychology coterminous with introspection can not enter far into this field, they still have their own genetic problems. In whatever direction we turn the harvest is waiting; it is only the reapers who are few. Almost every observation, experiment or theory of organic evolution offers parallel problems for the psychologist. The development of the individual opens questions more numerous and more important for psychology than does the development of the body for other sciences. Senile, degenerative and pathological conditions are all there for psychological investigation. The evolution of society and the inter-relations of individuals are being gradually brought within the range of genetic psychology. It is quite possible that the chief scientific progress of the next fifty years will be in this direction.

The problems of psychology are certainly made endlessly complex by the fact that we have to do not with the development and condition of a single mind or individual, but with innumerable individuals. The traditional psychology has been disposed to ignore individual differences; but in attempting to prescribe conditions for all minds, it becomes schematic and somewhat barren. It is surely wasteful to select those uniformities that are true for all and to throw away those differences which are equally fit material for scientific treatment.

Linnæus instructed his pupils to attend to species and to ignore varieties, and this in the end tended to make systematic botany and zoology unfruitful. If the zoologist had limited his work to the discovery of facts that are true for all animals and had ignored the differences between animals, he would have done something analogous to what the psychologist has actually done.

It may be that individuals can not be grouped into species or even varieties, but animals and plants are separated into species in accordance with the noticeable differences between them, and there are as many degrees of just noticeable difference between men as between related species. We have in any case the different species of the animal series and the different races of men for psychological study; it may be that instincts and mental traits have specific or racial significance for the zoologist or anthropologist. We have the infant, the child, the adolescent and the aged; we have the two sexes; we have the geniuses, the feeble-minded, the criminals and the insane—complex groups to be sure, but open to psychological investigation. It may be that mental imagery or types of character will give workable groups. But even if mental traits and their manifestations are continuous, we can study the continuum. The study of distribution and correlation appears to open up subjects of great interest and having important practical applications.

The question of the practical applications of psychology is the last which I shall touch. There are those who hold that there is something particularly noble in art for art's sake or in science divorced from any possible application. We are told of the mathematician who boasted that his science was a virgin that had never been prostituted by being put to any use. It is doubtless true that science justifies itself if it satisfies mental needs. It may also be true that pure science should precede the applications of science. But of this I am not sure; it appears to me that the conditions are most healthful when science and its applications proceed hand in hand, as is now the case in engineering, electricity, chemistry, medicine, etc. If I did not believe that psychology affected conduct and could be applied in useful ways, I should regard my occupation as nearer to that of the professional chess-player or sword swallower than to that of the engineer or scientific physician.

It seems quite obvious that such knowledge as each of us has of his own perceptions, mental processes and motor responses and of the reactions and activities of others, is being continually used, more continually indeed than any other knowledge whatever. This knowledge is partly organized into reflexes and instincts; it is in part acquired by each individual. Control of the physical world is secondary to the control of ourselves and of our fellow men. The child must observe

and experiment to fit itself into the social order, and we are always experimenting on it and trying to make it different from what it is. All our systems of education, our churches, our legal systems, our governments and the rest are applied psychology. It may be at present pseudo-science, in the sense that we have drawn conclusions without adequate knowledge, but it is none the less the best we can do in the way of the application of systematized knowledge to the control of human nature.

It certainly is not essential and perhaps is not desirable for every mother, for every teacher, for every statesman, to study psychology, especially the kind of psychology at present available. It is not necessary for a man to be either a psychologist or a fool at forty; he may, for example, be both. But surely it is possible to discover whether or not it is desirable to feed a baby every time it cries, to whip a boy when he disobeys or to put a man in prison when he breaks a law. If each man were given the work he is most competent to do and were prepared for this work in the best way, the work of the world all the way from the highest manifestations of genius to the humblest daily labor would be more than doubled. I see no reason why the application of systematized knowledge to the control of human nature may not in the course of the present century accomplish results commensurate with the nineteenth century applications of physical science to the material world.

The present function of a physician, a lawyer, a clergyman, a teacher or a man of business is to a considerable extent that of an amateur psychologist. In the inevitable specialization of modern society, there will become increasing need of those who can be paid for expert psychological advice. We may have experts who will be trained in schools as large and well-equipped as our present schools of medicine, and their profession may become as useful and as honorable. Such a profession clearly offers an opportunity to the charlatan, but it is not the only profession open to him. For the present the psychological expert should doubtless be a member of one of the recognized professions who has the natural endowments, special training and definite knowledge of the conditions that will make his advice and assistance of value. But in the end there will be not only a science but also a profession of psychology.

SHORTER ARTICLES AND DISCUSSION.

THE ANGEL STONE AT NEW HARMONY.

To THE EDITOR: I enclose a photograph which represents an interesting human document. In the years from 1814 to 1825 Johann Rapp was leader and prophet of the religious sect of Harmonists located on the Wabash River, at New Harmony, Indiana. In 1825, the property of this community was purchased by the colony founded by Robert Owen and William Maclure, and the Harmonists under Rapp removed to their new home at Economy, Pennsylvania.

In both locations the community was financially very successful, while their more enlightened successors scattered in dissension within two years. The success of the community under Rapp's guidance was due to the fact that it was an absolute tyranny, theocratic in its claims, and that all farming and business operations were directed absolutely by one mind.

Rapp had a way of miraculously appearing in the harvest field and in similar places, seemingly springing out of the ground. This he did literally, for it is said his successors found a number of tunnels leading from his house outward and opening in unsuspected places. Among other forms of divine guidance, Rapp had a visit each morning from an angel, who came barefooted and stood before him on a large stone, giving him direction for the affairs of the day. This stone is still preserved. It was presented to the Museum of the University of Indiana by the late Professor Richard Owen, son of Robert Owen of Lanark, the founder of the second colony of New Harmony. This stone in Rapp's

THE ANGEL STONE OF THE RAPP COMMUNITY AT NEW HARMONY, NOW IN THE MUSEUM OF INDIANA UNIVERSITY.

time showed clearly the prints of the angel's feet, and these, a little worn, are represented on the stone as it is preserved to-day. I owe the accompanying photograph of this stone to the courtesy of Professor Carl H. Eigenmann.

The stone suggests the sole condition under which communistic or socialistic organizations have been economically successful—that of complete subordination of the individual wills to the will of some one individual supposed to have mystic power or a divine commission.

DAVID STARR JORDAN.

DE MORGAN ON THE 'SHERMAN PRINCIPLE.'

TO THE EDITOR: Apropos of the papers which have recently appeared in the POPULAR SCIENCE MONTHLY and elsewhere dealing with the frequency distribution of word and sentence lengths in the writings of various authors, the following extract from a letter written by Professor De Morgan in 1851 is, I think, of some interest. The letter from which the extract is taken was written to the Rev. W. Heald, and is dated August 18, 1851. It is printed in the 'Memoir of Augustus De Morgan,' edited by his wife, Sophia Elizabeth De Morgan (pp. 214–216). After dealing with sundry other matters the letter proceeds in this way: "I wish you would do this: run your eye over any part of those of St. Paul's Epistles which begin with παυλος—the Greek, I mean—and without paying any attention to the meaning. Then do the same with the Epistle to the Hebrews, and try to balance in your own mind the question whether the latter does not deal in longer words than the former. It has always run in my head that a little expenditure of money would settle questions of authorship in this way. The best mode of explaining what I would try will be to put down the results I should *expect* as if I had tried them.

"Count a large number of words in Herodotus—say all the first book—and count all the letters; divide the second numbers by the first, giving the average number of letters to a word *in that book*.

"Do the same with the second book. I should expect a very close approximation. If Book I. gave 5.624 letters per word, it would not surprise me if Book II. gave 5.619. I judge by other things.

"But I should not wonder if the same result applied to two books of Thucydides gave, say, 5.713 and 5.728. That is to say, I should expect the slight differences between one writer and another to be well maintained against each other, and very well agreeing with themselves. If this fact were established there, if St. Paul's Epistles which begin with παυλος gave 5.428 and the Hebrews gave 5.516, for instance, I should feel quite sure that the *Greek* of the Hebrews (passing no verdict on whether Paul wrote in Hebrew and another translated) was not from the pen of Paul.

"If scholars knew the law of averages as well as mathematicians, it would be easy to raise a few hundred pounds to try this experiment on a grand scale. I would have Greek, Latin and English tried, and I should expect to find that one man writing on two different subjects agrees more nearly with himself than two different men writing on the same subject. Some of these days spurious writings will be detected by this test. Mind, I told you so. With kind regards to all your family, I remain, dear Heald,

"Yours sincerely,

A. DE MORGAN."

Comment regarding this remarkable anticipation of supposedly very modern ideas seems superfluous.

RAYMOND PEARL.

THE PROGRESS OF SCIENCE.

THE TWO HUNDREDTH ANNIVERSARY OF THE DEATH OF LOCKE.

JOHN LOCKE, who was born on August 29, 1632, died on October 28, 1704, a century before the death of Kant, and two centuries before that of Spencer. The two hundredth anniversary of Locke's death was commemorated by the British Academy, where papers by Professors Fraser and Sir William Pollock were read, and at Johns Hopkins University, where Principal C. Lloyd Morgan, Professor F. J. E. Woodbridge, Professor J. McBride Sterrett, Dr. Wm. T. Harris and Dr. William Osler made addresses. Locke ranks in eminence with his contemporary Leibnitz, who controverted his teaching, and with the sage of Königsberg, upon whom he was destined to exert a powerful influence, although Lockism and Kantism have come to mean almost diametrically opposite ways of regarding the world. The friend of Boyle and Newton, he was always interested in experimental science. As a student and practitioner of medicine, he was intimately associated with Sydenham, by whom he was frequently consulted.

Locke's education was in some respects unconventional and his life one of varied incident. Taught at home until his fourteenth year, he was sent for a time to public school, thence to Oxford, with which he was connected as a student or a lecturer successively in Greek, rhetoric and philosophy for many years. At one time he was dismissed by order of the king for alleged complicity in schemes against the crown, but he was already securely ensconced in Holland, where he became the recipient of the favor of William of Orange, under whom he resumed his residence in England after the great revolution. During the troublous times which preceded, he had been actively interested in business and particularly in political affairs, chiefly through his connection with the Earl of Shaftesbury, and had held important public offices. While living in the family of Shaftesbury, as physician, adviser and general literary and social factotum, he undertook the education of an only son of the household. He took an active part in the formation of the Colony of Carolina and at one time contemplated emigrating to America. Never strong, he especially suffered from poor health after middle life, yet he was always of a cheerful and sociable disposition. He was well on towards sixty when he began to publish the series of works which have made him famous. The products of mature reflection, each of his books was nevertheless called forth by some concrete situation and directed to a definite, practical end. This circumstance, together with their candor and common-sense and the freshness of their style, which is remarkably free from technicalities, early won for even the most obscure of his productions a favorable reception among all sorts of readers, and gave his writings a permanent place in literature.

The 'Essay concerning the Human Understanding,' his most important book, contains his philosophy of knowledge and his classic contributions to psychology. Philosophy before Locke had been highly metaphysical as to its problems, and dogmatic in its method. It took a fresh start under the criticism of Locke, who deliberately set himself the preliminary task of inquiring 'into the original, certainty and extent of human knowledge, to-

gether with the grounds of belief, opinion, and assent.' How do we come by our knowledge and what are its limits? These are the problems which Locke regarded as fundamental, and Locke gave to the solution of these problems. By introspection he was led to affirm that the mind knows only its own ideas, whence subjective idealism was sure to ensue. In no case do

JOHN LOCKE.

with which philosophy has been largely preoccupied since his time. Many of the difficulties which modern speculation has encountered owe their origin directly to the curious turn which we known things, but only ideas which somehow represent things, thought Locke. He denied the existence of innate ideas of any kind, insisting that all the mind's ideas are acquired afresh by

each individual's experience. The mind is a *tabula rasa*, a perfect blank, to start with. Experience is, however, of two kinds, *viz*, 'sensation,' whereby ideas of the qualities of external objects are acquired, and 'reflection,' whereby the mind becomes aware of its own operations, *i. e.*, acquires ideas of them. But the mind is marvelously capable of transforming the ideas which experience supplies to it by combining the 'simple ideas,' which are the ultimate data of experience, into 'complex ideas,' by discriminating simple components in complex experiences, by comparison, abstraction, etc. Locke's psychology, which is subservient to his avowed purpose of discovering the origin and limits of knowledge, is rationally one-sided, and is now largely obsolete, but he abounds in observations and analyses of permanent value. He was the first to speak of the 'association of ideas,' although he made no general use of the conception.

Locke's views on education powerfully influenced Rousseau. Education has for its aim the development of 'a sound mind in a sound body.' Physical education is of prime importance, and should consist in a process of hardening the body to endurance, special attention being paid to exercise, fresh air, sleep, diet, clothing and the like. Intellectual and moral education should aim at the development of a virtuous character, a self-respecting and self-supporting English gentleman, wherefore sound morals, good manners and skill in some trade or handicraft were regarded as essential, and given a place above mere learning. Locke thought the schools of the time unfitted to provide this training, and recommended private tutorial instruction. The studies should be useful, should appeal to the natural interest and aptitude of the pupil, and in matters of morality the child's sense of honor should be relied upon, corporal punishment giving place to moral suasion.

Influential as a moralist, an economist, and the leader in many public reforms, Locke was preeminently a defender and expositor of liberty. In a time of religious bigotry he wrought famously and well for toleration, and his name will be forever enshrined in those doctrines of civil rights which molded the public sentiment that gave birth to the United States. Before Jefferson drafted the Declaration of Independence, Locke had declared that 'all men are naturally in a state of freedom, also of equality.'

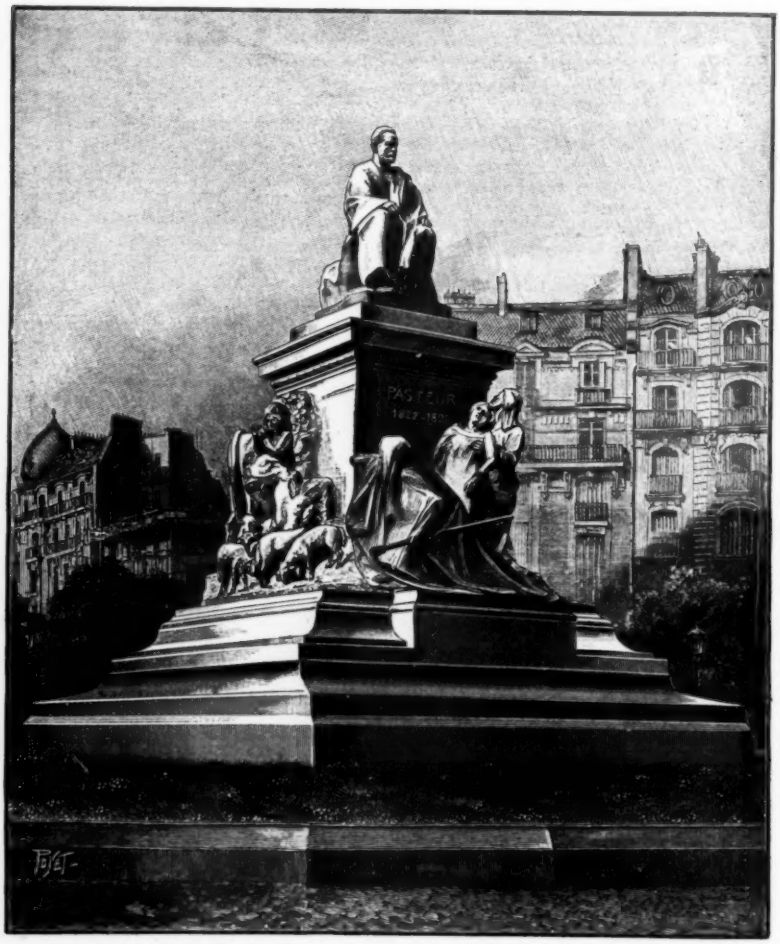
Locke has been rightly called the 'intellectual ruler of the eighteenth century,' and while it would not be safe to say that he is the greatest of English philosophers, he is certainly the most characteristically English, and probably the most widely influential.

THE MONUMENT OF PASTEUR AT PARIS.

In France scientific men are not without honor in their own country. It is probable that the conditions are more satisfactory here, where scientific work is adequately supported both by the state and by private endowments, although the scientific worker is likely to be unknown outside his own circle. But reputation and fame have so long been regarded as the rewards of certain kinds of service that the homage paid in France to a man such as Pasteur may attract young men to a scientific career, even though it may not be a very important factor in stimulating their subsequent work. Monuments in memory of Pasteur have been erected in various parts of France. At Dôle, where he was born; at Arbois, where he lived as a child; at Marnes-la-Coquette and Vaucresson, where he lived in later years; at Besançon, Lille and Alais, whose silk-worm industries he saved; at Melun and Chartres, where he performed the same service for the cattle and sheep.

Pasteur's chief monument is indeed the Institute Pasteur, erected and en-

dowed in his life time by public subscription, and now containing his tomb. But there was recently unveiled at Paris a monument, of which an illustration is here reproduced from *La Nature*. The figure in marble is the last work of the eminent sculptor Falguière, who died before it was completed. Around the base are allegorical figures, humanity offering a child to be cured of the most dreaded disease, a shepherd relieved from all anxiety for his flock, and the like. The monument, for the erection of which about $70,000 was contributed by international subscription, was unveiled in the presence of the president of the republic and his cabinet, and commemorative addresses were made by those most competent to tell of the work of one of the greatest of men of science and of benefactors of his race.



MONUMENT OF PASTEUR.

PROFESSOR VAN'T HOFF.

IN 1895 the Prussian Academy of Sciences called Professor J. H. van't Hoff from the chair of chemistry at Amsterdam to Berlin. He was to receive a salary and a laboratory and was to have no duties other than those which he might choose to assume. In

order that van't Hoff might lecture if he wished, he was appointed to a professorship at the University of Berlin, also without specified duties. The remarkable feature of this arrangement is that it was primarily as a member of the Academy that van't Hoff went to Berlin. No such honor has been paid a man in Germany since the time of Frederick the Great. An outline of van't Hoff's career will prove that the tribute was deserved.

When only twenty-two years old van't Hoff showed that certain unexplained cases of isomerism would be accounted for if structure formulas were so written as to represent the arrangement of atoms in space and not merely relations in a plane. The importance of this new point of view lay in the fact that it enabled chemists to classify substances which rotate the plane of polarized light and to predict what substances will possess this property. The branch of chemistry known as stereochemistry is the outgrowth of the paper published by van't Hoff in 1874 and of the independent statement of the same idea by LeBel a few months later.

In 1878 van't Hoff was appointed professor of chemistry, mineralogy and geology at the new University of Amsterdam. From this time forward his work has been in physical chemistry rather than in organic chemistry. In the next six years he rediscovered the law of mass action; he worked out the generalized theory of reaction velocities; he showed that the quantitative relation between chemical affinity and heat effect has the same form as the relation between electrical energy and heat effect deduced by Helmholtz. In addition to this he established the theorem which bears his name, on the quantitative displacement of equilibrium with change of temperature.

In 1885 a new period begins. Some experiments by the botanist, Pfeffer, were the starting-point. Pfeffer had been studying the rise of sap in trees and had found that a high pressure is necessary to prevent the diffusion of water through a membrane of colloidal copper ferrocyanide into a solution of sugar in water. Van't Hoff showed that the results of Pfeffer could be predicted if it were assumed that a dissolved substance exercises an osmotic pressure equal to the pressure which it would exert if converted completely into a gas occupying the volume of the solution and having the same temperature. This assumption not only explained Pfeffer's results; but also those of Raoult on the vapor-pressures, boiling-points and freezing-points of solutions. When the osmotic pressure theory of solutions was supplemented by Arrhenius's theory of electrolytic dissociation, it needed only the energy and enthusiasm of Ostwald to raise physical chemistry in the short space of twenty years to the position which it now holds.

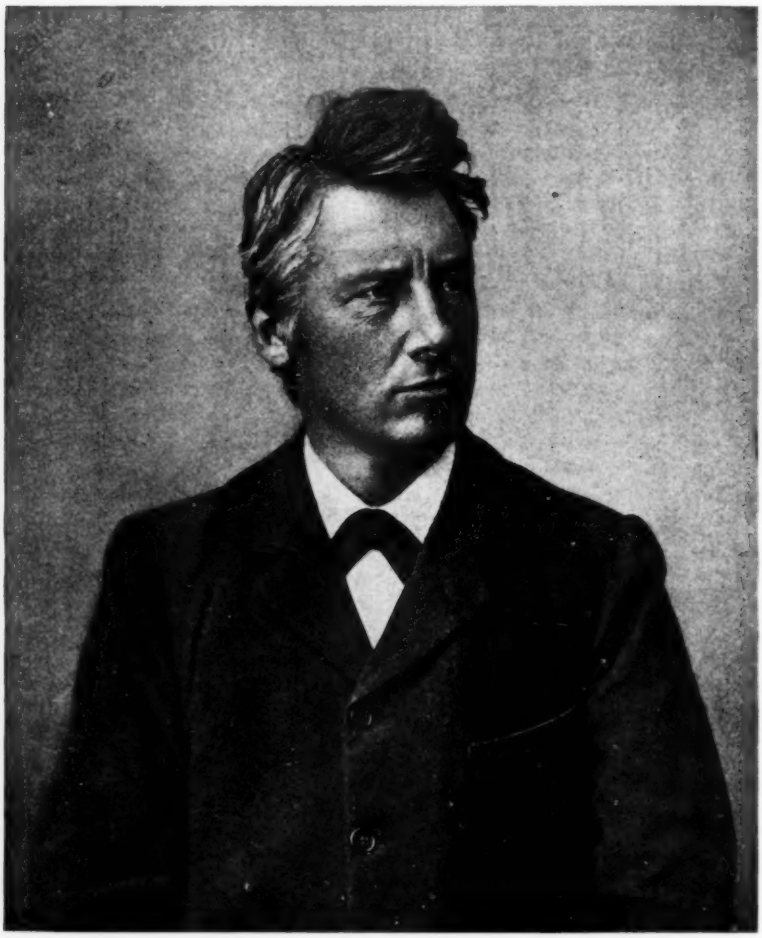
In 1894 van't Hoff was offered the chair of physics at Berlin, made vacant by the death of Kundt. This was declined; but the ideal position offered by the Prussian Academy in the following year was accepted and van't Hoff left Amsterdam in 1896 for Berlin. Since that time he has worked systematically at a problem which had interested him off and on for many years previously. What this problem is can be learned from van't Hoff's own outline of his plans in an address before the Prussian Academy on July 2, 1896.

"The line along which I shall work is clear; the application of mathematics to chemistry remains my chief aim, and each opportunity to promote this in my new surroundings will be welcome. For the present, therefore, I shall devote myself to that portion of physical chemistry which deals with the so-called inversion phenomena, with the formation of double salts, and with double decomposition. The application of mathematics is possible in this field and there is the fascinating prospect of applications to the Stassfurt industry and to geology.

"I do not need to state that industrial applications will not be the object of the work. I have left my native land because I know that in Germany, more than elsewhere, we find widespread the conviction that the pursuit of knowledge for its own sake is the highest aim of human efforts."

phates of sodium, potassium, magnesium and calcium. Although not yet finished, the work is a masterpiece and shows what can be expected from an application of physical chemistry to geology and mineralogy.

The work of van't Hoff can be divided crudely into four parts: 1872–1877, or-



PROFESSOR J. H. VAN'T HOFF, BERLIN.

The special form of the problem was a systematic study of the conditions of equilibrium in their bearing on the salt deposits at Stassfurt, but the general results are applicable to all cases in which the deposits consist chiefly of any mixtures of the chlorides and sul-

ganic chemistry; 1878–1884, chemical affinity; 1885–1895, theory of solutions; 1896–1904, oceanic deposits. Much of the organic chemistry of today is the direct outcome of the work done in the first period; the second and third periods made physical chemistry

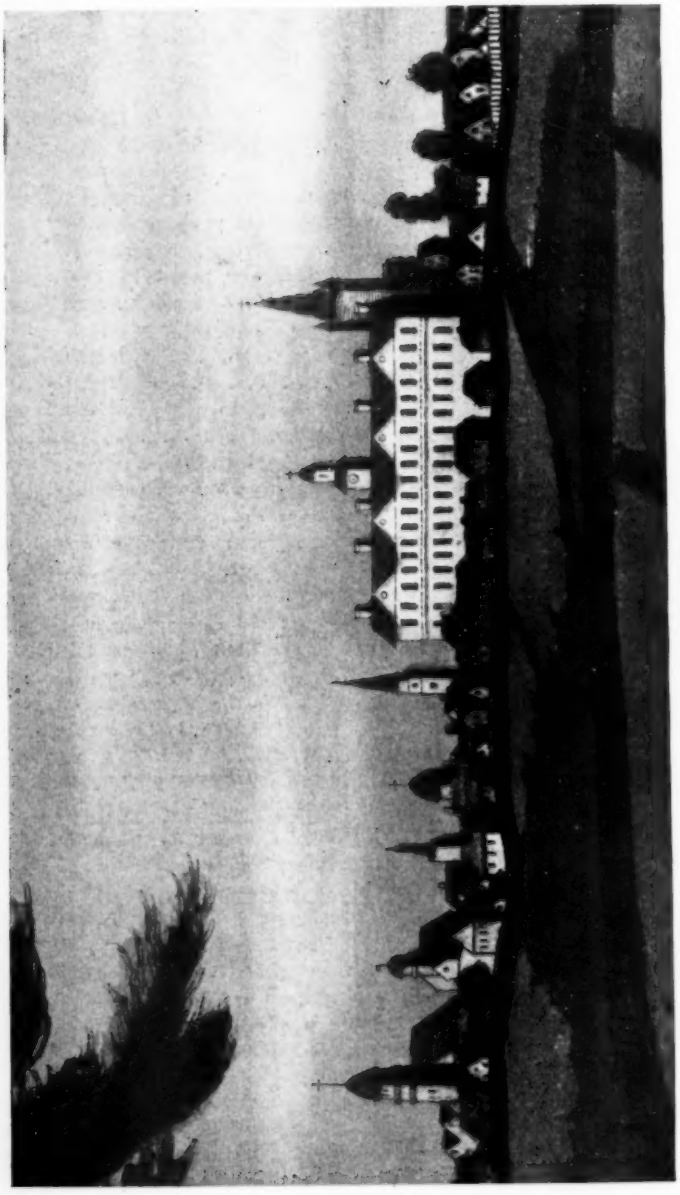
possible; the fourth period has probably introduced a new era in geology, of which the geophysical laboratory at Washington is a sign. It was because van't Hoff is a great exponent both of organic chemistry and of physical chemistry that he was the first man to be awarded the Nobel prize in chemistry. A man who commands the whole field of chemistry and who is deemed able to fill the chair of physics at the University of Berlin as successor to Kundt is a man who is well worthy of the exceptional honor paid by the Prussian Academy of Sciences to van't Hoff.

THE HUNDRED AND FIFTIETH ANNIVERSARY OF COLUMBIA UNIVERSITY.

COLUMBIA UNIVERSITY, which received its charter as King's College in 1754, appears to be the sixth in age of American Colleges, having been preceded by Harvard (1636), William and Mary (1692), Yale (1701), Pennsylvania (1740) and Princeton (1746). Our universities are young in comparison with European institutions, whose obscure beginnings go far back into the medieval period; but it may be called to mind that the University of Berlin was founded in 1809 and the University of London in 1836. Our colleges were, indeed, established early in the history of the settlements, New York having been a trading village of less than 15,000 inhabitants when 'a public lottery was authorized to raise money for the advancement of learning and towards the founding of a college.' The first president, Samuel Johnson, in the announcement issued in 1754, offered an ambitious if somewhat vague program of studies. He proposed "to instruct and perfect the Youth in the Learned Languages, and in the Arts of *reasoning* exactly, of *writing* correctly, and *speaking* eloquently; and in the Arts of *numbering* and *measuring;* of *Surveying* and *Navigation*, of *Geography* and *History;* of *Husbandry*, *Commerce* and *Government*, and in the Knowledge of *all Nature* in the *Heavens* above us, and in the *Air*, *Water* and *Earth* around us, and the various kinds of *Meteors*, *Stones*, *Mines* and *Minerals*, *Plants* and *Animals*, and of every Thing *useful* for the Comfort, the Convenience and Elegance of Life, in the chief *Manufactures* relating to any of these Things." Dr. Johnson being the entire faculty until his son was added, it may be assumed that the actual course was limited to 'the learned languages' and elementary mathematics. The first professorship, however, was in mathematics and natural philosophy, established in 1757, when Dr. Johnson, in accordance with the original agreement, 'retired to some place of safety out of town when the smallpox prevailed.'

Columbia was a comparatively small institution until about 1860, but it has taken a leading part in the development of scientific education. A medical school was established in 1767, two years after the first American school had been founded in Philadelphia. In 1864 was established the School of Mines, the first institution of the kind in the country. In the small faculty of the college have been a considerable number of prominent scientific men, including Bard, Hosack, Mitchill, Adrian, Torrey, Newberry, Egleston and Rood. Barnard, president from 1864 to 1889, was a scientific man of eminence, who had broad ideas on education. After President Low's inauguration in 1890, a notable development followed, not least evident in the enlargement of the scientific departments, and this development continues under the administration of President Butler. Columbia now stands in the small group of the leading universities of the world, both in number of students and in contributions to the advancement of knowledge. It has earned the right to celebrate with satisfaction its one hundred and fiftieth anniversary.

The exercises were scarcely so elaborate as the Princeton sesquicentenial and the Yale bi-centenial. A large reception to the alumni was given by the



KING'S COLLEGE IN 1760

COLUMBIA COLLEGE IN 1857

(From a daguerreotype reproduced in the *Photographic and Fine Art Journal*, June, 1857)

trustees on October 28. On October 31 there was a university convocation, when President Butler made a commemorative oration and degrees were conferred on distinguished alumni. There was a banquet of the alumni in the evening and various other gatherings. Perhaps the most interesting event, as witnessing the continual growth of the university, was the dedication of the building for physical education of Teachers College, erected and furnished at a cost of $400,000 and the laying of the cornerstones of a chapel, of a school of mines building and of two dormitories. The school of mines is built in the same general style as the four buildings for the sciences already erected. The dormitories must be adjusted to a city environment, where land is expensive, the two city blocks on the side of which they stand having cost $2,000,000. In connection with the celebrations, there has been published by the Columbia Press a history of the university prepared by Dean Van Amringe and other authorities, which is a work of interest not only to alumni, but also to all who are concerned with the history of higher education in the United States.

THE FORESTS OF THE HAWAIIAN ISLANDS.

Mr. William L. Hall, in charge of forest extension of the Bureau of Forestry, has drawn up a report on the forests of the Hawaiian Islands which is of some general interest. The forests are of two entirely different kinds, which in no case meet. Those near the sea-level consist of a single species, now covering at least fifty thousand acres, all of which sprang from a single algaroba tree, which grew from a seed planted in 1837. These forests have considerable economic value. They supply cord wood and posts, and live stock feed on the pods. The land occupied by these trees is mostly worthless for any other purpose; they are so hardy and so fully appreciated by the people that they will be cared for without any special action on the part of the government.

The conditions are different in the case of the native forests, which cover or formerly covered the mountains of the islands. These forests, which consist of lehua, koa and other native trees are tropical in character, containing none of the familiar trees of the north temperate zone. The trees are not very valuable commercially, but the forests themselves are said to be of the utmost value in conserving the water supply of the islands. There is an abundant and luxuriant undergrowth with a great quantity of humus, possessing an enormous capacity for holding water. When the forests are cleared, either purposely or by accident, there is danger that there will not be enough water conserved to supply the sugar plantations. These supply the chief industry of the islands, the exports of sugar being valued at some $25,000,000, ninety-six per cent. of the total exports of the islands. The forests have in part been destroyed in a curious way. Cattle were introduced into the islands in the eighteenth century and were turned out to run at large. They trampled down and ate the undergrowth, without which the ground dries up and the shallow-rooted trees die. Goats, pigs and deer also run wild in the forests. In view of the conditions cooperation of some character is essential, and the people of Hawaii have through their legislature passed a bill creating a forest reservation, and appropriating $28,000 annually for its support. A trained forester has been appointed, and the work is being carried forward with the cooperation of the Division of Forestry of the Department of Agriculture.

SCIENTIFIC ITEMS.

Professor Clemens A. Winckler, the eminent chemist, died at Dresden on October 8, at the age of sixty-six years.—Professor Nils Finssen, of Copenhagen, known for his discovery of the light cure for lupus, died on Sep-

INTERIOR OF LEHUA FOREST.

tember 24. A committee has been formed to collect a fund for the erection of a monument.—Professor Max Bartels, of Berlin, known for his publications on ethnology, died on October 22, at the age of sixty-two years.—Major Henry F. Alvord, chief of the dairy division of the United States Department of Agriculture, died at St. Louis on October 1, as the result of a stroke of paralysis.

PROFESSOR SIMON NEWCOMB has been elected a corresponding member of the Vienna Academy of Sciences.—The medal of the Society of Chemical Industry, awarded every second year for services to applied chemistry, has been presented to Dr. Ira Remsen, president of the Johns Hopkins University.—It is reported that the Nobel prize for medicine will this year be awarded to Dr. Robert Koch. He has been presented with a portrait bust and a *Festschrift* on the occasion of his sixtieth birthday.—Columbia University has conferred the degree of D.Sc. on Sir William Ramsay, the retiring president, and on Mr. W. H. Nichols, the president-elect, of the Society of Chemical Industry.—A memorial tablet to Dr. Jesse Lazear, who died in Cuba in 1900 while investigating the causes of yellow fever, has been unveiled at the new surgical building of the Johns Hopkins Hospital.—King Edward has directed that a new medal be struck for service in polar regions. The officers and crew of the Antarctic exploration ship *Discovery* will be the first recipients of the medal.

THE St. Petersburg Institute of Experimental Medicine has sent an expedition to the shores of the Black Sea to inquire into the prevalence of malaria, especially in the neighborhood of Gagory.—The Liverpool School of Tropical Medicine proposes to despatch a second yellow fever expedition to the Amazon in view of the necessity of investigating still further this malady. The late Dr. Walter Myers was selected by the school, together with Dr. Herbert Durham, to undertake an expedition to Para to investigate the disease, only a few years ago. Both members of the expedition were attacked by the malady and Dr. Myers died. The expedition will probably start at the end of the year.—Professor Robert Koch has recently returned from Detmond, where he was engaged in investigating an outbreak of typhoid fever for the German government, and has since been at Paris, where he was entertained by the Pasteur Institute. In the course of the winter he will proceed to German East Africa in order to continue those studies of tropical and other diseases which he had not completed during his recent visit to Rhodesia. In particular he will continue to investigate the part played by ticks in conveying the infection of various cattle diseases.